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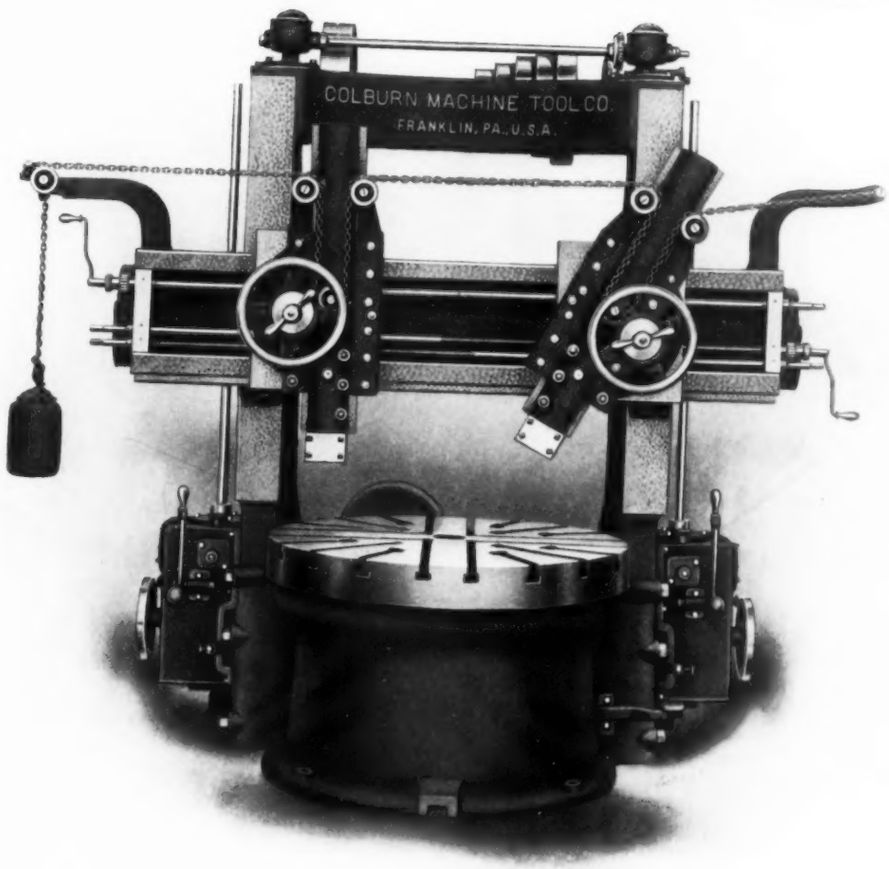
Index to Advertisers and Classified Index Following Reading Matter.

COLBURN



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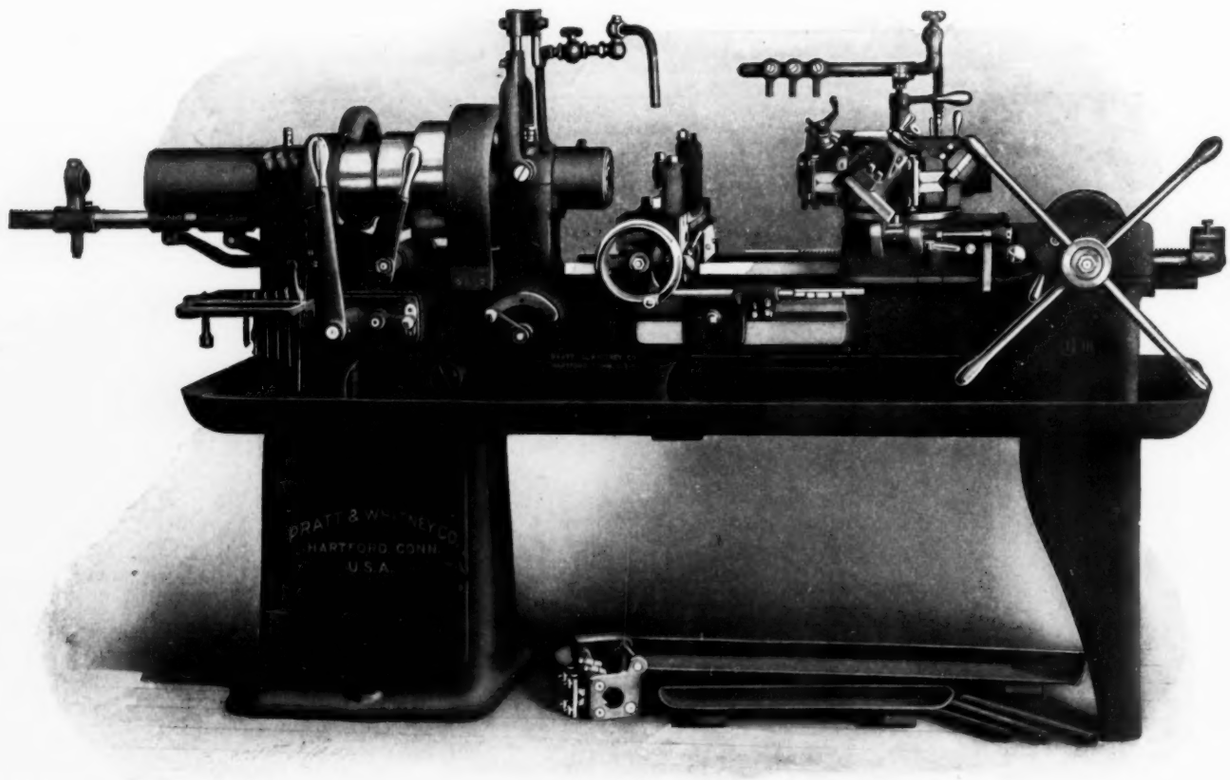

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Shop Notes from Denver.

EDITORIAL CORRESPONDENCE.

AUTOMATIC INDEXING SPIRAL PLANING ATTACHMENT.

Fig. 1 illustrates a planer attachment for spiral planing which works on the well-known principle of a rack engaging a gear on the work mandrel and arranged transversely of the platen, while made to reciprocate across the platen by an inclined guide attached to brackets bolted to the planer bed. By using a long worm in place of the usual rack, and adding a ratchet and pawl for turning the worm at each reciprocation of the platen, the fixture is made to index the work, which is the spiral grooving of flour mill rolls.

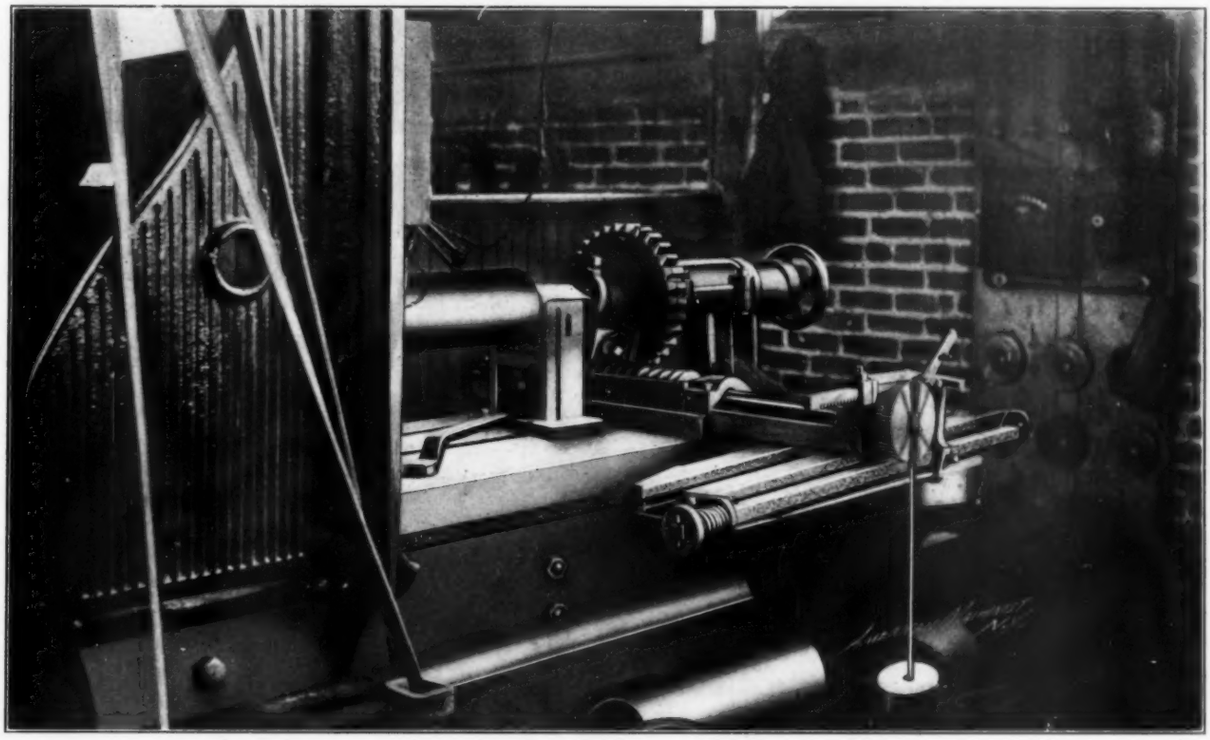


FIG. 1. SELF-INDEXING SPIRAL PLANING FIXTURE.

The rack and gear action of the worm and worm wheel will be clear from the illustration. The turning of the worm is by the ratchet and pawl at the end of the worm shaft, the movement being obtained from the vertical arm which surrounds the horizontal square bar and which, at the end of the stroke, engages a stop on the bar and is thus given a reciprocating motion relative to the platen. To insure uniform movement of the arm, regardless of the variation in the length of stroke of the platen, the bar is backed up by a spring at its near end. The adjustment is such that the movement of the arm is completed before the end of the platen movement, the excess of which is taken up by a movement of the bar under the pressure of the spring, any variation in the length of the platen's movement being taken up by the spring and the movement of the arm being uniform.

SHAFT-STRAIGHTENING MACHINES.

Fig. 2 shows a machine for straightening and burnishing lengths of line shafting, although the working parts are so concealed by the framework that the action is not as clearly shown as might be desired. Two inclined shafts, driven by universal couplings, carry heavy rolls, which lie at an angle with one another, as indicated. One of these rolls is slightly concave in profile, while the other is straight. The shaft to be straightened is fed in endwise between the two rollers dividing the angle between them and under heavy pressure by them. The action of the straight roller is to spring the shaft into the bottom of its mate, and as the rollers revolve the shaft revolves with them and is slowly fed through—the bending action passing continuously around it and along its length, and it thus emerges straight, and, incidentally, burnished, by the heavy rolling pressure. The line taken by the shaft in passing through the machine may be made out by the position occupied by the two semi-circular guides for it, which are located each side of the driving gears.

Fig. 3 shows a very convenient straightening press for miscellaneous work. The hydraulic press is supported by a carriage of which the rollers run on the lower flanges of the I-beam shears of the machine, and it may thus be quickly adjusted to any desired position. The headstock carries driven rollers on which the end of the bar to be straightened rests when being revolved for testing its straightness, the tailstock having a similar pair of rollers, which, however, are not driven. Between the headstock and tailstock are two substantial rests with hour-glass shaped roller supports for the shaft, the rollers having eccentric bearings by which they may be quickly raised or dropped a limited distance. When raised they lift the shaft from the headstock and footstock rollers and carry its weight, and when dropped they transfer the weight to the end rollers. It will be obvious at once that by dropping the roller rests and thus transferring the weight of the shaft to the headstock and footstock rollers, the former of which are in motion, it will revolve and its high side may be marked with the usual piece of chalk, and that by raising the rests its weight will be transferred to them, its movement will stop and the press may be brought to the required point for straightening the bar. In actual use these actions alternate. The headstock rollers are in constant motion, and by merely turning the handles of the eccentric rests the bar is made to revolve or stand still, as desired. The machine is long enough to take in any length of merchant bar, and by suitable setting of the footstock, eccentric rests and pump, it may be treated locally and its kinks be taken out.

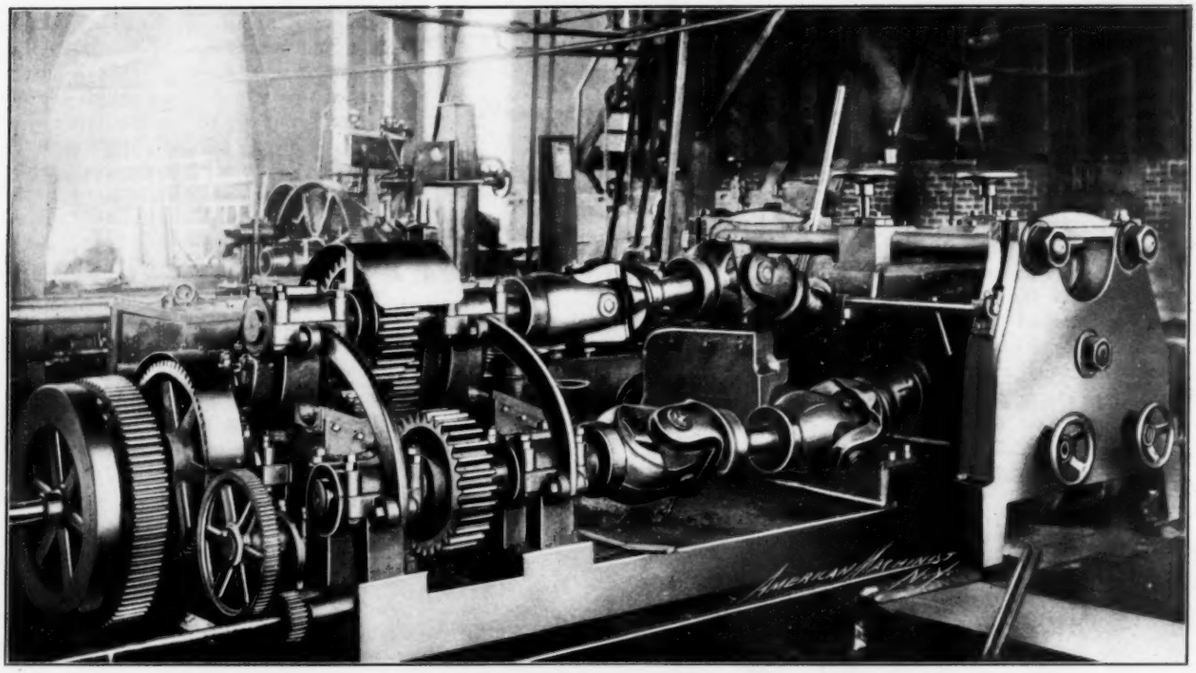


FIG. 2. SHAFT-STRAIGHTENING MACHINE.

GRINDING MACHINE FOR CURVED PROFILES.

Fig. 4 shows a grinding machine with an attachment for grinding the curved profiles of the rollers used in the machine shown in Fig. 2. The machine has an ordinary lathe bed, with a special footstock for carrying the bearings of the rollers to be ground. A bent, flat bar spans the space between headstock and footstock and carries a curved former plate, which has the profile of the desired roller. A guide spans this bar and connects with the emery-wheel slide, which is carried on a carriage of lathe style. The reciprocation of the carriage along the bed obviously

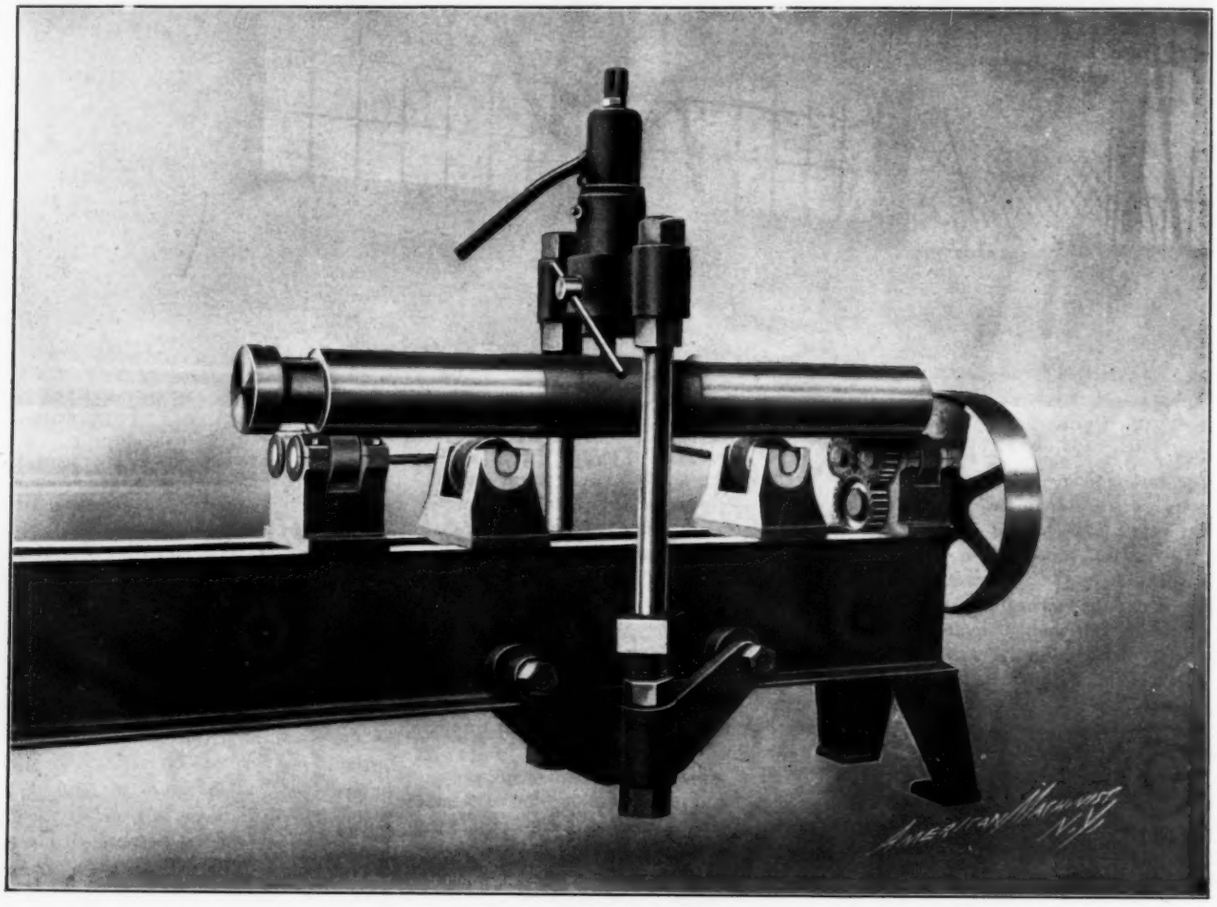


FIG. 3. STRAIGHTENING PRESS.

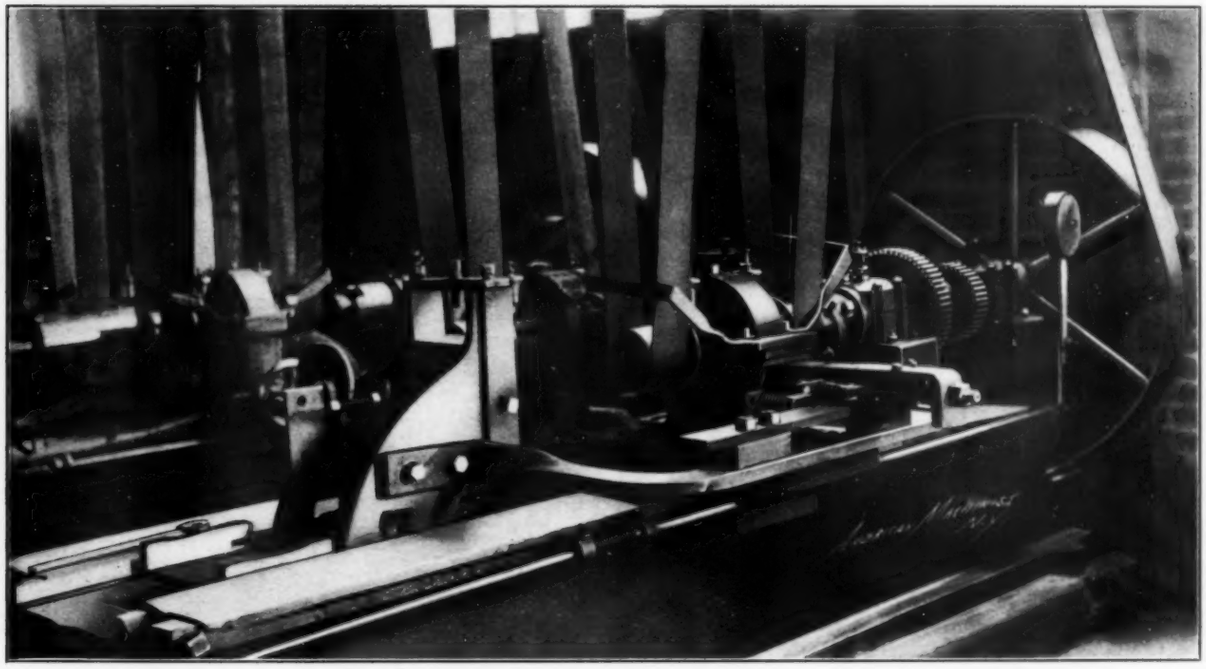


FIG. 4. GRINDING MACHINE FOR WORK HAVING CURVED PROFILES.

gives a cross movement to the wheel, corresponding with the curve of the former plate. All of the above machines are in use at the shop of the F. M. Davis Iron Works Company.

RIG FOR DEEP-SHOULDER BORING.

One of the products of the Denver Engineering Works Company is the Box electric rock drill, the containing shell of which is in halves and has a bore of the pattern shown in Fig. 5. The main bore of 4 inches diameter is required to be of a good degree of accuracy, and is finished with a reamer which is put through the entire length before the offsets are bored. The counterbores are required to be of only such accuracy as is obtainable by a boring tool set to a graduated scale. The main bore completed and reamed, the work is mounted on the fixture shown in Fig. 6. A stiff boring bar is mounted as shown, the problem being to direct the workman to the proper locations of the various shoulders and to the proper depths of the counterbores, which, obviously, are in a position to make their direct measurement almost impossible.

The lathe used has a taper turning attachment, which is utilized as a support for a brass measuring bar on which are ruled a series of lines representing the various interior shoulders of the work. The lathe carriage carries a piece of brass with a beveled edge arranged to register with the lines on the measuring bar. By suitable initial adjustment, the tool is made to just scrape the end of the work when the edge of the brass piece registers with the end mark, and then it is only necessary to run the tool within the work until the brass piece registers with the second mark to locate the tool for the first shoulder, and so on for the others. The depth of the various counterbores is obtained by direct reading from a pair of scales laid on the wing of the lathe carriage, as shown. As a matter of fact, longitudinal lines are ruled on the measuring bar which have eluded the camera, these lines representing the depths of the counterbores, the bar thus being a drawing of the bore in brass. The various diameters are also stamped on the bar for the guidance of the workman, who thus need not consult his blueprint at all.

BORING AND TURNING SPHERICAL SEATS FOR BALL-AND-SOCKET BEARINGS.

The Denver Engineering Works Company makes a good deal of use of bearings for large shafts which are mounted ball-and-socket fashion for automatic alinement, these bearings being for shafts as large as 9 inches, requiring a ball-and-socket joint of 16 inches diameter. Fig. 7

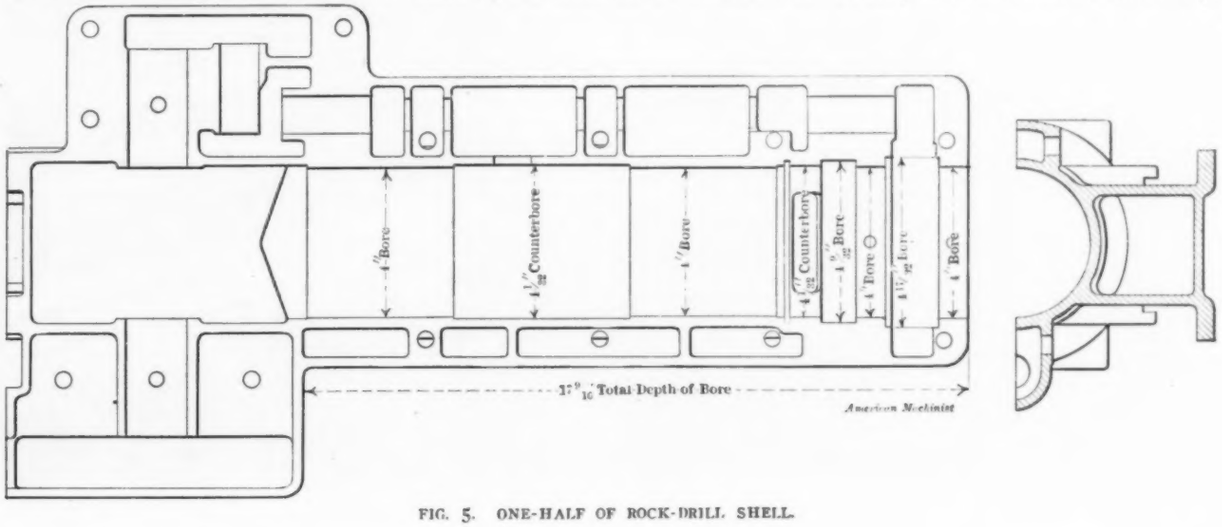


FIG. 5. ONE-HALF OF ROCK-DRILL SHELL.

shows the rig for turning the balls and Fig. 8 shows the boring bar for the sockets. Fig. 7 will be seen to utilize the taper-attachment lathe again. The taper bar is, however, removed, and in its place is substituted a plate having grooves of circular arc form into which suitable blocks fit. These blocks are pivoted to the bar, which controls the cross movement of the tool block which obviously follows the groove in the plate. Grooves of various radii for different sizes of work are included in the block.

The boring bar, Fig. 8, is used in a horizontal spindle boring machine, the bearing *a* being carried by the usual tail support and thus prevented from longitudinal movement. The end *b* is attached to and driven by the live spindle and partakes of its endwise feed. The part *c* being stationary, as regards end movement, the feed of *b* obviously causes the tool holder *d* to swing on its pivot and bore the seat to the required form.

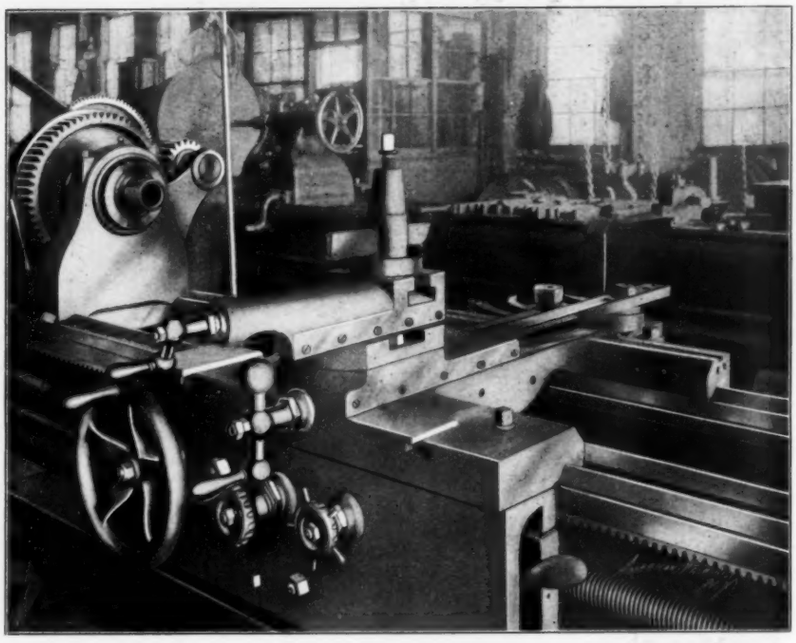


FIG. 7. FIXTURE FOR TURNING BALL JOINTS FOR BEARINGS.

A NEW USE FOR THE AUTOMATIC GEAR CUTTER.

Fig. 9 shows an extremely effective milling operation from the shop of the Geo. E. Lyner Engineering Works Company. The machine shown is a Gould & Eberhardt automatic gear cutter, but it wouldn't recognize the work it is doing. The place usually occupied by a gear in process of being cut is here occupied by a 6-hole turret for carrying as many valve cages for the Lyner rock drill. These cages screw to place in the rock drill and are required to have a hexagon end for the wrench. They come to this machine finished, except for the hexagon, the ends to be milled being, in the rough, a full round in order to avoid complication with their presentation to the milling cutters when screwed home in the turret. Each turret hole carries a socket, into which the work is screwed, and having a star for revolving it as the turret turns and a latch bolt for correct indexing of the work. The straddle mills finish two sides of the hexagon at a time, the turning of the work as the turret revolves presenting fresh sides until each piece has gone three times around, when it is removed by hand and a fresh one is sub-

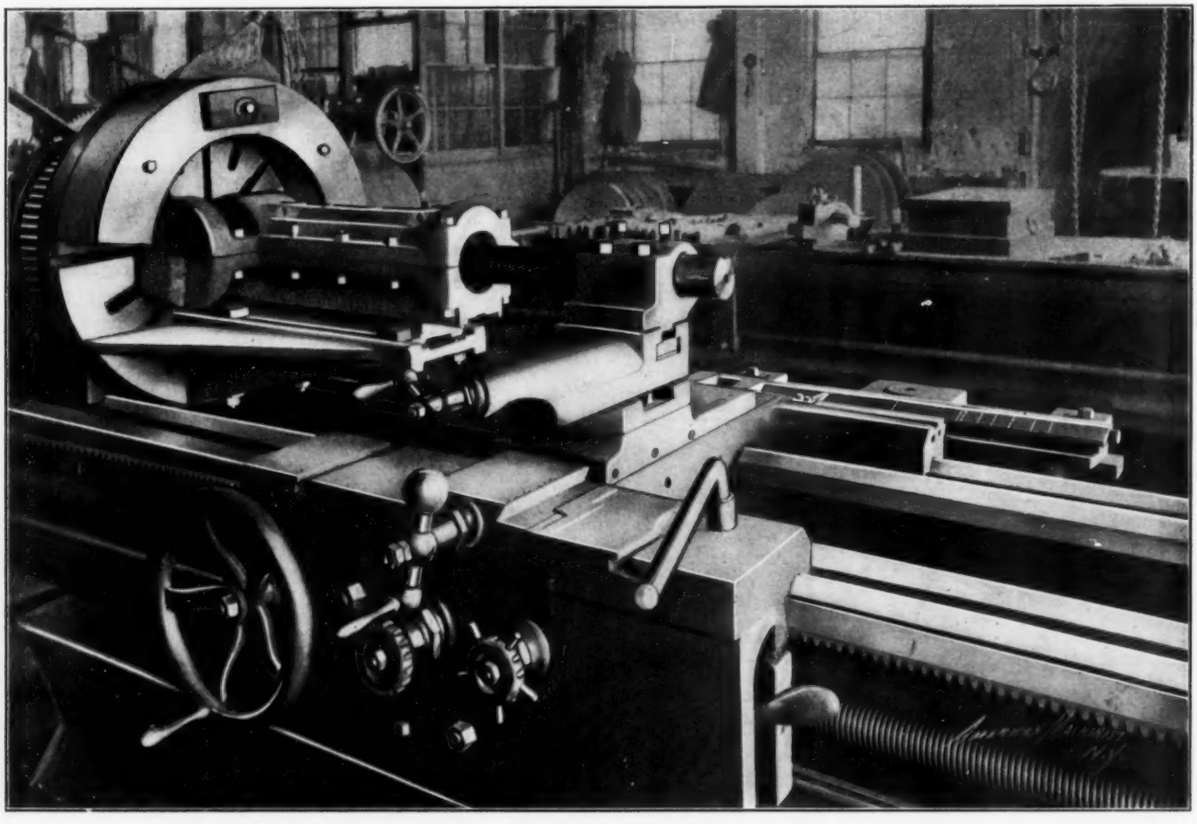


FIG. 6. BORING OFFSETS IN ELECTRIC ROCK-DRILL SHELL.

stituted. The standing still of the turret while the milling is being done gives ample time for removing and replacing the pieces with the machine in motion. The revolving of the turret is by the regular indexing movement of the machine and the turning of the work holders in the turret is automatic.

SUPPORT FOR LONG TURRET LATHE JOBS.

Fig. 10 shows a fixture from the Lyner works, of which several are in use and which has considerable range of application. The work in progress is the boring of a piece which is so long as to be insufficiently held from side spring by the chuck jaws. The frame shown is bolted to the chuck and has four steadying screws for the outer end of the work. The work is driven by the chuck jaws, the screws of the fixture being tightened sufficiently to give side support only.

KEYSEATING RIG.

Fig. 11 shows a novel keyseating rig, also from the Lyner works.* The bar carries a tool shown just without the gear which is being keyseated, and which is mounted on a swivel pin for relief during the back stroke, and has a spring return to the cutting position. It slides through the vertically adjustable swivel bearing mounted on the platen, the bearing being swiveled to permit the feeding movement, and is also swivel-jointed to the driving piece which is bolted to the clapper. This driving piece is extended above the clapper bolt and has a set-screw by which the clapper is held down.

To plane a parallel keyseat the seat is first scribed on the face of the gear or pulley hub and the bar is adjusted horizontally by a surface gage with the edge of the tool in line with the bottom of the keyseat when the planer head is raised until the tool clears the bore of the work and the cut is begun. At the beginning the bar is inclined and the cut with it, but when the cut reaches full depth the bar is again horizontal and the cut likewise. To plane a taper keyseat the bar is set with the tool edge in line with the scribed line on the hub but with the bar inclined to the desired taper, this being obtained by measuring under the bar. The head is then raised and the cut is made as before.

SOME COMPRESSED-AIR TOOLS.

The remaining illustrations are from the Denver shops of the Denver & Rio Grande Railroad, and they show, as pictures from railroad shops are very apt to show, applications of compressed air.

Fig. 12 shows a rotary air drill in the act of grinding in the brass connecting piece which joins the T-connection to the branch steam pipes in the smoke-box of a locomotive. The joint between the two parts is a ball and socket and the air drill supplies a very ready means of doing the work. While the piece is revolved by the action of the drill it is given an oscillating

*Patented by J. L. Oefinger.

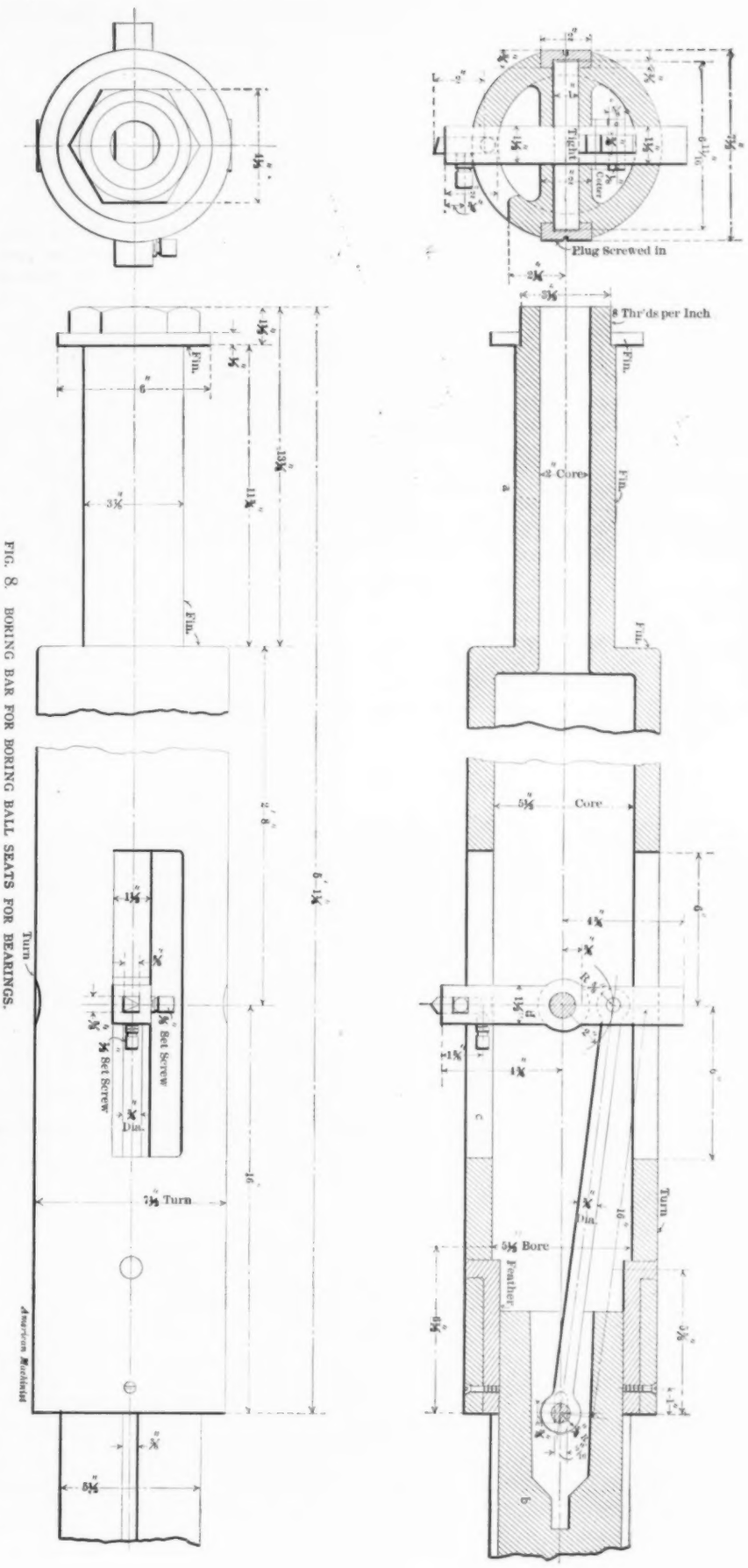


FIG. 8. BORING BAR FOR BORING BALL SEATS FOR BEARINGS.

sidewise movement by the workman and the grinding is quickly done.

Fig. 13 shows an appliance for closing up the clamps which bind air-brake hose to their couplings. The air cylinder at the rear closes a movable jaw on the clamp and compresses it while the workman inserts the bolt and tightens the nut.

Fig. 14 shows two other applications of compressed air to air-brake hose work. At the left an air cylinder operates a pair of cut nippers by which the clamps on old hose are cut in two and removed, and at the right are two cylinders for inserting couplings in new and removing them from old hose. The vertical cylinder operates a wood vise clamp for holding the hose, while the horizontal one operates a clamp fitted to grasp a coupling and insert or withdraw it as desired.

Fig. 15 shows the valve used with the appliances shown in Figs. 13 and 14, as well as in many more. It is a simple plug cock of which the two ends are connected respectively with the two ends of the cylinder. The admission and exhaust of the air are through the plug, as indicated by the arrows. A quarter turn of the plug suffices to reverse the connection of the ports, as clearly shown in the different views. The fancy valves supplied by the makers of air hoists have all been replaced at this shop with cocks made on this simple principle.

PLANING VAUCLAIN CROSSHEADS.

Fig. 16 shows a planer equipment for planing the crossheads of Vauclain compound locomotives. The crosshead is carried by two mandrels inserted in the piston-rod holes and supported by V-blocks, one pair of which have tongues fitting a slot in the platen in order to insure alinement. A U-shaped tool-holder carries two tools for planing both sides of the crosshead simultaneously. By inverting the crosshead and mandrels in the V-blocks the opposite side is presented to the tools and in a manner which obviously insures correctness in the two sides with respect to each other and to the piston-rod holes. F. A. H.

The Russian Government having sanctioned the use of spirit for illuminating, heating, and other practical purposes, after it has been denaturated, there is presented a splendid opening for lamps to burn spirit instead of petroleum, according to the British consul at Kieff. Such lamps have been imported from Germany, but are not yet quite perfect. There is also a wide field open for the development for small-sized stationary engines, traction motors and motor cars using denaturated spirit as fuel. Nearly every fairly-sized estate owns its own distillery.—*The Engineer.*

A British battle-ship being built at the Portsmouth docks is to be equipped with Parsons steam-turbine machinery and Babcock & Wilcox water-tube boilers.

Core Practice and Sands Used for Cores in Various Parts of the Country.

BY R. H. PALMER.

While, in many parts of the country, molding sand is brought some distance, the sand used for making cores for coring the molds is that found nearest at hand, and the treatment of these different sands varies according to their good or poor qualities. A good core, in the general acceptance of the term, is one which will stand the strain it is subjected to, from which the gases escape easily, thus allowing the iron to lay to it, that does not fuse together with the heat, that leaves the casting easily, and that when removed, leaves a clean hole in the casting the shape of the core. Some of the sands in use while able, of themselves, to withstand the action of a light body of metal around them, will not stand the action of a heavy body, thus calling on the foundryman to supply to the sand some property it lacks to enable it to stand up to its work.

In southern New England may be found many deposits of a clean, white hill sand ranging from coarse to fine, and being what I would call a quartz sand. It used to be said in that part of the country that a mason wanted a clean, lively sand for plastering. Experience had taught the foundryman that a clean, white sand which, when dry, ran easily from the hand was an open sand which, made into a core, gave one of an open, porous nature through which the gases given off by the binder, etc., easily escaped when the core was surrounded by molten metal. He wished a clean sand, as the more loam and other foreign substances it contained, known to him as dirt, the more gas was generated in connection with the binder and mixer, together with the closing up of the pores, thereby causing the iron not to lie quietly to the core, and in its action to eat into the core, or to produce blow-holes around the hole in the casting formed by the core. Thus in that part of the country the staple core sand is the nearest quartz, white, hill sand.

In some other parts is to be found an open hill sand of different shades of color. Some of the yellow sands, while standing a light body of iron, will, with a heavy body, burn up to a sort of charcoal, and

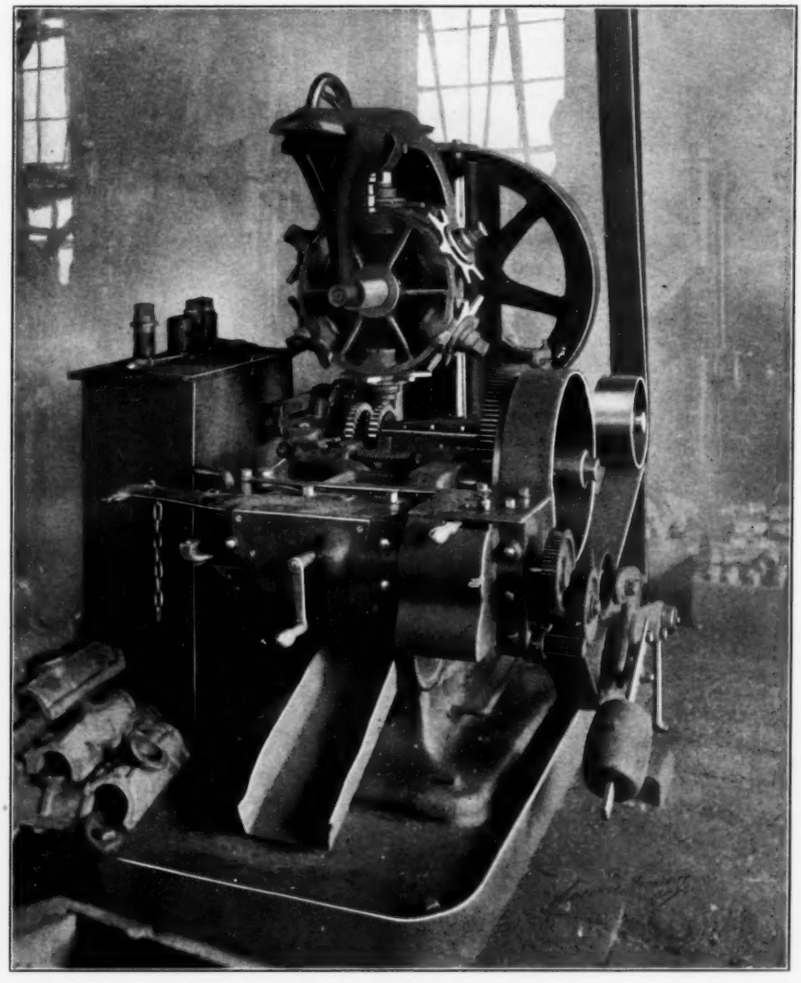


FIG. 9. MILLING HEXAGONAL CAPS ON AN AUTOMATIC GEAR CUTTER.

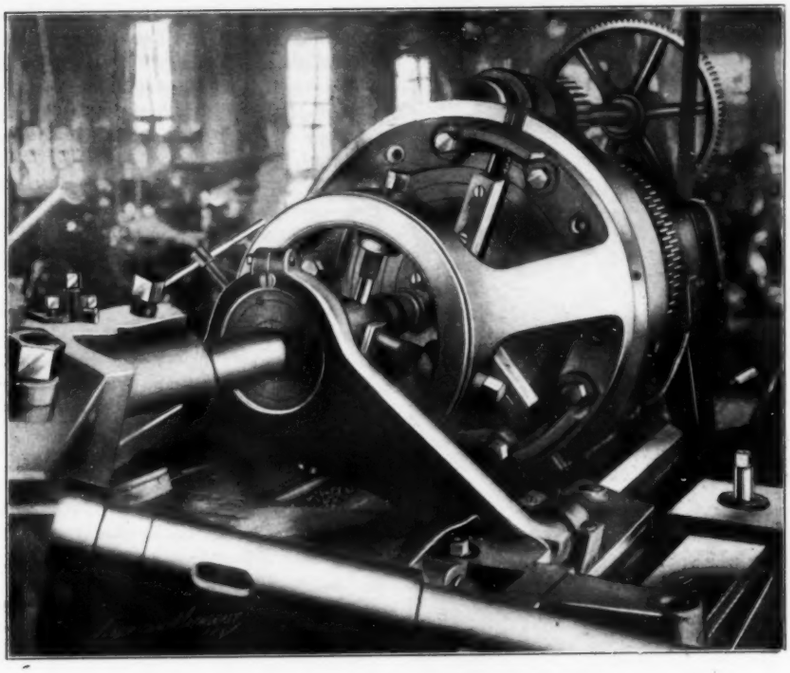


FIG. 10. SUPPORT FOR LONG-TURRET LATHE WORK.

go to dust, and are only forced to stand up to a heavy body of metal by the addition of Jersey fire sand, or molding sand and clay.

In western New York the lake sand is the favorite, and I may say throughout the territory where it can be obtained cheaply. When in the interior of New York I found deposits of sand that, under a magnifying glass, appeared to be what I would call a mixture of quartz and slate, and as there were plenty of slate stones in the vicinity, I think I am right. This sand stood the action of the iron well; it was open and lively.

In some parts of Pennsylvania the sand used is dredged from rivers, or taken from the river sand-bars. Complaint is now made that there is more coal in it than formerly, owing to so much coal-washing going on.

Comparing the white hill sand of New England, the lake sand and the river sand of Pennsylvania, I could not see a great deal of difference, except for the greater or less quantity of earthy, perhaps I should say loamy, matter, the body of all being a quartz sand.

In speaking of New Jersey, I do not think any one State is better known to the foundrymen of the Eastern and Middle States in connection with sand, or clay. One has called to mind the many good qualities of Jersey fire sand, Millville gravel, and how many times they have helped him out.

In Ohio ground silica rock is used to some extent.

In connection with the sand for core-making some bond or binder must be used. In some parts of the country rye meal was formerly used, as it still is by some. For light work the sand was mixed 18 or 20 parts of sand to one of rye meal; for heavier cores the proportion was 1 to 14 or 16, and the mass was wet up with returns from a distillery. This made a good open core. As the work varied, coarse molding sand or Jersey fire sand was added. As the process of making flour continued and was cheapened, a flour known as Red Dog was made, which sold at a low price and flour took the place of

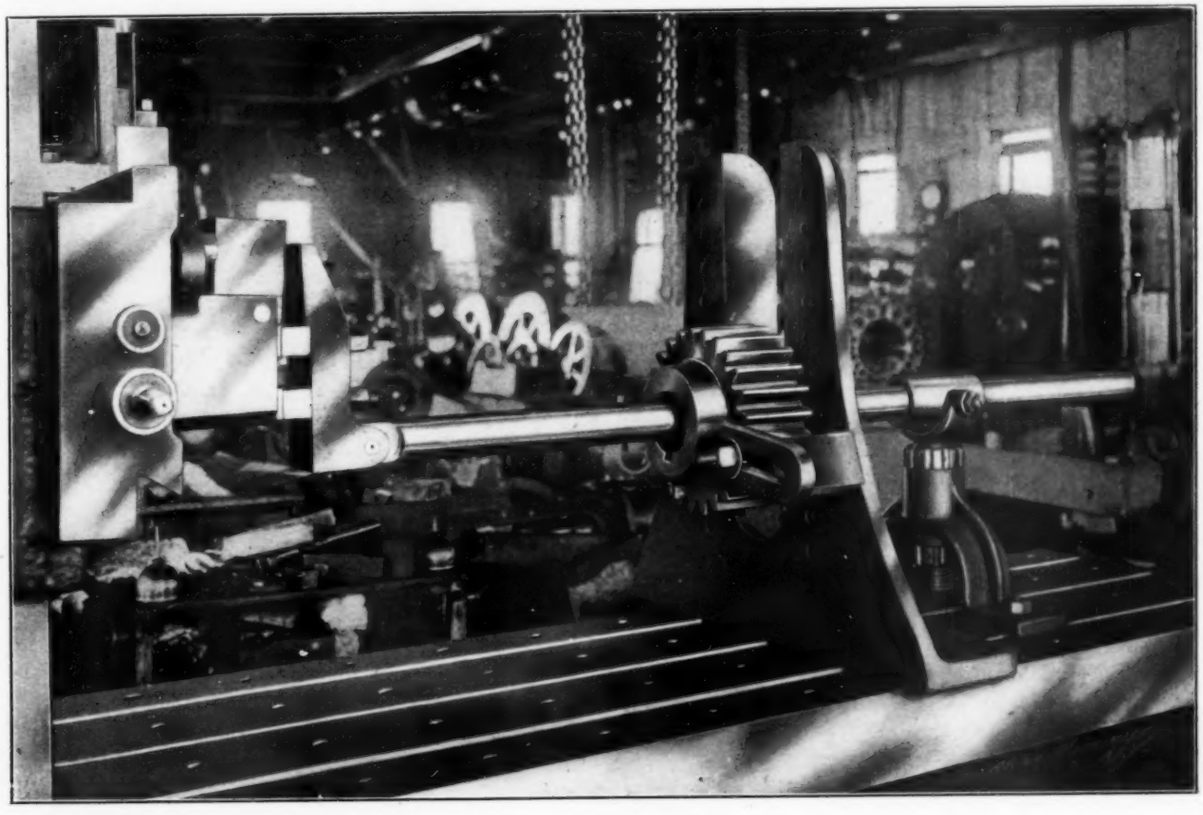


FIG. 11. KEYSEATING RIG.

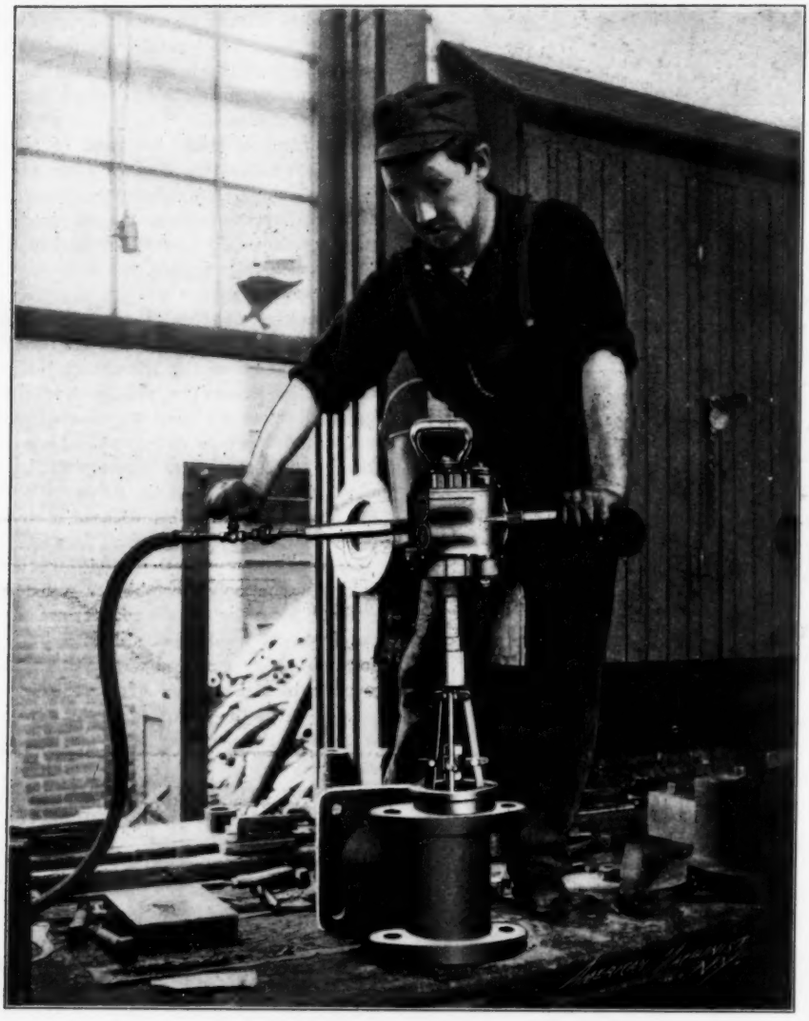


FIG. 12. GRINDING BALL AND SOCKET JOINTS.

rye meal. Black strap molasses took the place of returns, the molasses being diluted with 18 or 20 parts of water, according to the body of the molasses. Rosin, ground or pounded up by hand in a mortar and sifted, has been used in connection with flour, and it was found that a core made with rosin would stand dampness better than one made with a flour mixture. Cores have been made containing a certain proportion of linseed oil, and used successfully. The above refers to small cores used when a smooth hole was wanted in such castings as those of agricultural machinery, in which the holes were not to be bored, or reamed. These cores left a smooth hole where fine sand was used, but on the whole were too expensive to come into general use for small cores. Mixtures containing fish oil were also used. These last stood the dampness. When a core has to be left in a mold a long time before the mold can be filled with hot iron, and the core mixture is such that the core gathers dampness from the mold, such a mixture is the cause of more or less loss to the foundryman, on account of the cores blowing, and breaking. Thus a founder may be near a salt-water beach where plenty of clean beach sand may be had, but the sand is so impregnated with salt from the ocean that cores made from it cannot be left very long in the mold, as they draw moisture, whereas the sand from fresh water is satisfactory.

With the advent of electricity as a motive power, and the gas and gasolene engine, there has arisen a demand for a class of castings requiring what may be termed a delicate class of cores, yet from which delicacy considered as a lack of strength must disappear, and rigidity and strength take its place.

While in the general construction of cores the coremaker relies on the placing of iron rods in the cores to stiffen and strengthen them to withstand the strains, yet he so arranges them that when the core is removed from the casting the rods may be easily taken out, working on the principle that "what he puts in a core must come out with the core from the casting." In many of the castings wanted in the class of work referred to, the cores are so thin, say down to 5-16 inch in thickness, that it is hard to arrange any network of wires to give the required strength. On general principles, the molder arranges a series of small vents, or channelways in the cores, bringing one or more openings to the print surface, and to this opening in the core he arranges a channelway in the mold for the gas to escape to the outside of the mold where it can be lighted and thus drawn from the core while the mold is filling with the melted iron. The channelways for vents would be a source of weakness in thin cores, and if the rods or wires are not surrounded by enough sand the hot iron burns to them,

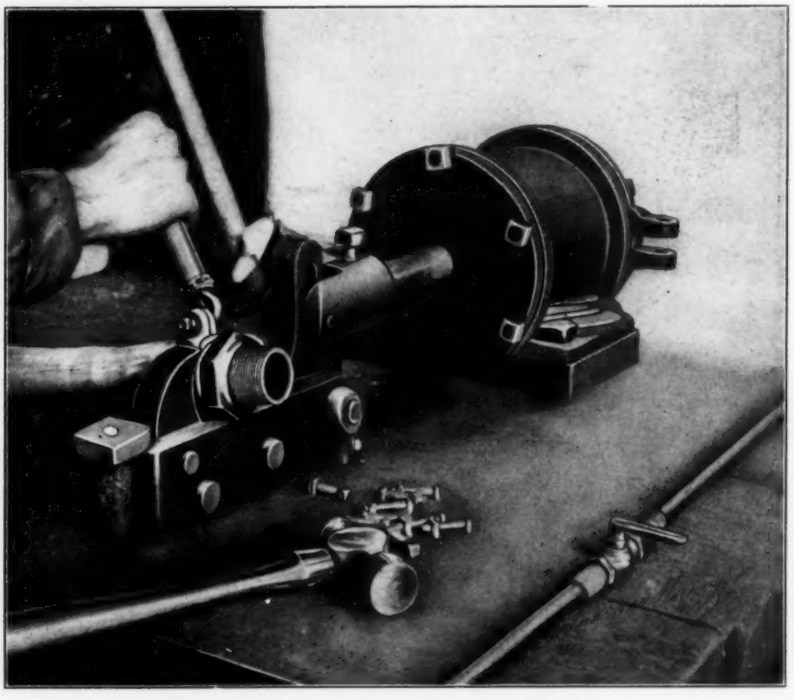


FIG. 13. PUTTING CLAMPS ON AIR-BRAKE HOSE.

thus making them stick to the casting and making them hard to remove, as well as hard to get in when the core is made. Again, some of these cores give very little chance for an outlet for the gas through the prints.

In some castings the metal surrounding the core is thin, and a blacking used on such cores may cause more or less cold-shuts. Many patterns give but little provision for either the escape of gases from the castings, or the removal of cores from the castings, the whole combination throwing on the market a class of castings which, while bringing a fancy price, are not profitable to the foundryman using the old style of core mixtures, as most of those mixtures generate quantities of gas, and as there can be no provision made for the escape of these gases fast enough, the iron is blown out of the mold by the gases generated by the cores in the mold or the core is broken.

A careful study of the facts and conditions forced itself on the foundryman. He has found with the introduction of the core machine for making stock cores that certain qualities were needed in the sand mixture. The less gummy the mixture, the better the machine works, as the sand pressed through it is packed harder than usually rammed by hand. He finds that a clean, open sand is wanted, with a binder of as oily a nature as possible.

With the above class of work it is found that a clean quartz sand is wanted, with a binder added to it of a nature to form a strong, yet close, core to resist the iron, of itself producing a minimum amount of gas, yet capable of being burned up in the casting, so that the sand may easily run out of the casting in cleaning, and leave a clean hole in the casting the shape of the core.

With this end in view a great deal of money and time have been spent in experimenting to produce core compounds, or binders, to take the place of flour, rosin and rye meal. Some of these compounds proved to be but stepping stones in the right direction, for while the good qualities referred to were wanted, there is another continual cry in the foundry: It must be cheap; it must reduce expense. It has been a continual eyesore to some that this class of work brought a good

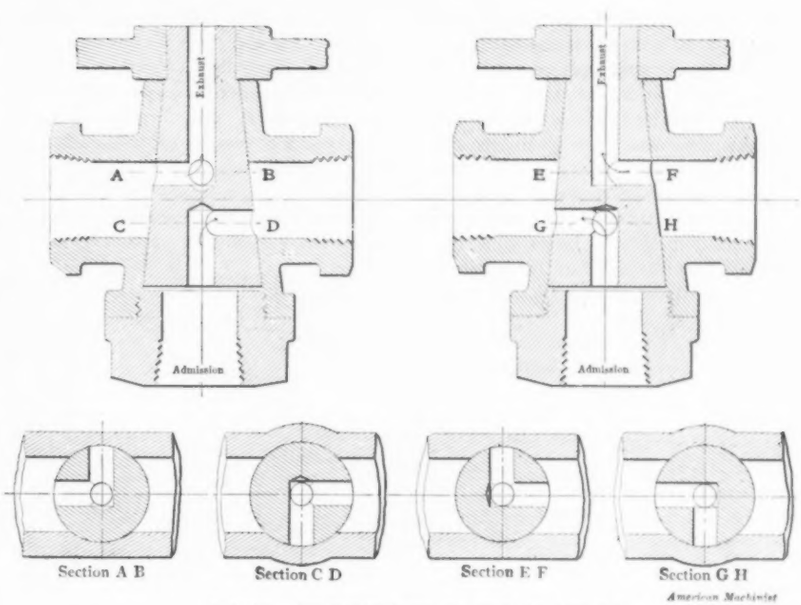


FIG. 15. AIR VALVE USED IN FIGS. 13 AND 14.

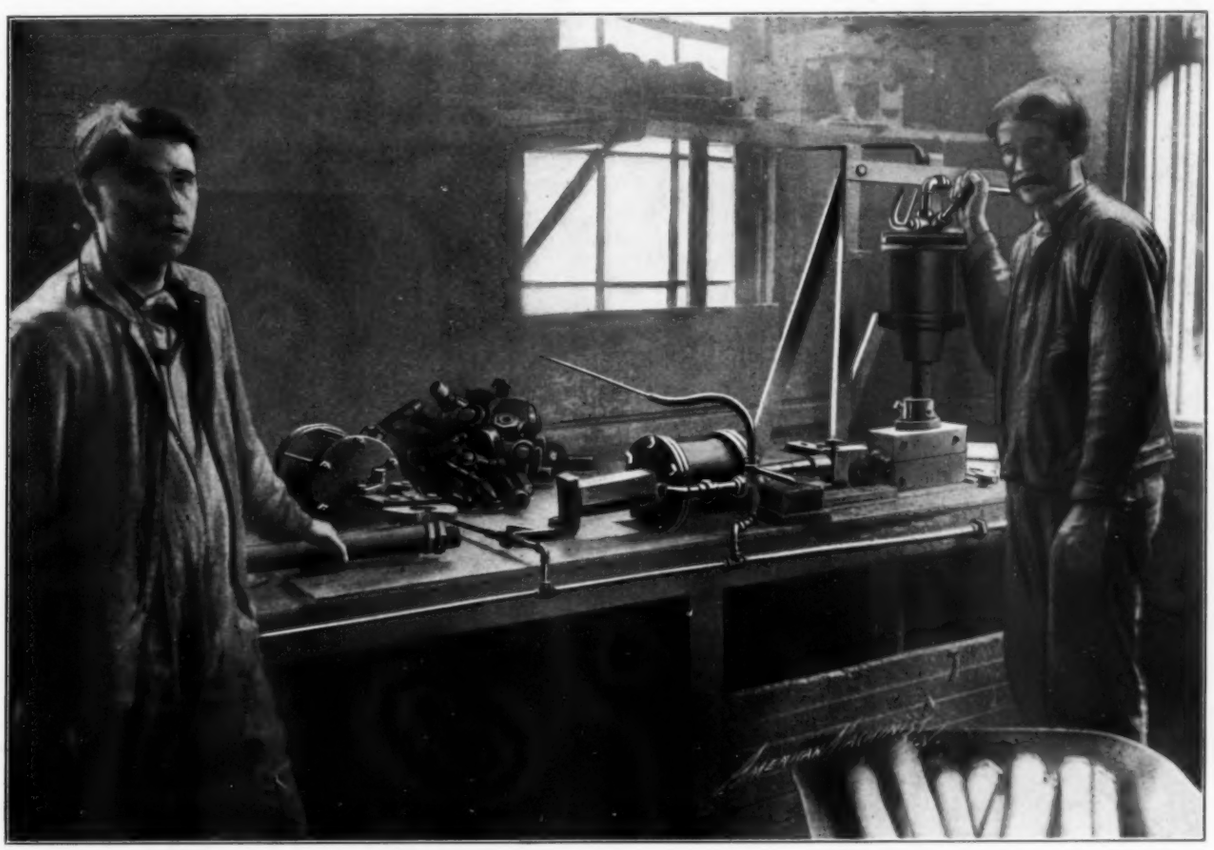


FIG. 14. CUTTING HOSE CLAMPS AND INSERTING COUPLINGS.

price apparently, but there was little money in it on account of the cores.

At last core compounds and oils have been put on the market that are being used in the leading foundries of the country with satisfaction. The first core compounds were made, as well as I can remember, more with the idea of making an open core that would dust easily and, when the casting was cleaned, leave it easily, but no attempt was made to give the core additional strength by the use of the binder and thus do away with the strengthening of the core by rods.

The recent core binders, known as compounds, and oils, have it as one of their good qualities that cores made with them require less rodding to strengthen than when made with flour. They also stand the dampness, where flour cores do not. Many cores that formerly required rodding are now made entirely without rods, relying on the binder for strength. While some of these compounds cost in the neighborhood of 30 cents per gallon, it is found that they do the work, that the loss of castings is so much less when they are used than with old mixtures, that they are not only money-savers, but there is a certain satisfaction in being able to see good work coming out of the foundry.

There never was a new machine, or mixture, or any departure from the old rut in the foundry that I know of, that did not lead to a growl somewhere. But core compounds have come to stay and make friends. "By their works shall ye know them."

The C. E. Mills Oil Company, of Syracuse, N. Y., and the National Jeloluse Company, Forty-third street, New York, are making good core compounds, though I do not mean that they are the only ones by any means, as probably others are doing as well.

I consider it safe to say that if core compounds were taken from our foundries to-day there would be an outcry in good earnest. With them on some classes of work founders who are placed where core sand is expensive have been enabled to use some of the old sand over, also gangway sweepings in some classes of cores. To anyone who has been following the old ruts I would say, try some of the core compounds and oils, and I am confident that a saving on some class of core work will be effected.

FIG. 16. PLANING VAUCLAIN CROSSHEADS.

The Construction of Crane Drums.

BY JOSEPH HORNER, BATH, ENGLAND.

A crane drum is an article the functions of which are simple, but the details of which are subject to many variations, and especially so of late years, since wire ropes, high speeds, and big cranes have been in demand.

The commonest, and formerly nearly the only type used, is the plain drum, Fig. 1, on which chain lies with the links diagonally. These drums are generally made from complete patterns of wood, being too large for metal patterns. But as drums of the same diameter are being constantly wanted at different lengths for various cranes, the patterns are made in two forms. One is absolutely standard, the flanges being securely and permanently attached to the drum body, and never altered from year to year. Then another pattern of the same diameter, but as long as the longest drums are ever likely to be wanted, Fig. 2, is kept in the stores. On this one flange only, that to the left hand, is permanently fixed, and a body flange *A* is attached temporarily, wherever required to make up any length of drum. The stopping-off piece seen at *B* makes the mold good. These drum castings are cored with swept-up loam cores, struck on a revolving core bar. Only in very small dimensions is a core box used.

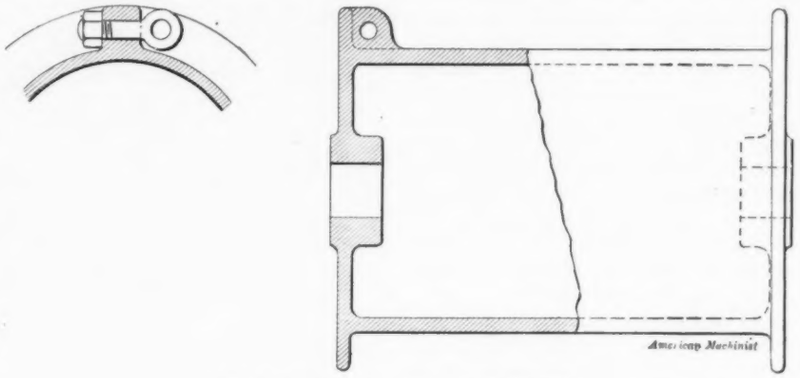


FIG. 1. PLAIN DRUM WITHOUT GROOVES.

When the attempt is made to guide the chain, a helical groove is formed as in Figs. 3 and 5. In Fig. 4 the chain lies diagonally, just as on the plain drum, Fig. 1, which subjects the links to strain sideways. This is prevented if the grooves are made as in Fig. 5. But the flat links cannot lie quite flat on the convexity of a small drum, so that there is a slight bending strain in the longitudinal direction. This is quite negligible in the larger drums, though noticeable in those of small diameters.

Grooved drums are nearly always used for wire rope, and the grooves are made of rather larger radius, Fig. 6, than the rope, to prevent chafing between the edges of the grooves and the rope.

Grooves are formed of one hand only, or both right and left hand, Fig. 3, the

latter almost invariably in the longer drums, so that the load being lifted shall not travel from one side toward the other, but remain in one perpendicular position. Spiral grooves are also properly formed in fusee drums, Fig. 7, for derricks, though many chain derricks have plain drums. Frequently derricking drums have the ratchet cast at one end, Fig. 8. In some derrick cranes the plain drums are cast with a ratchet at one end and a claw clutch at the other, Fig. 9. In such a case the ratchet must be made in a core box, the drum being molded with its longitudinal axis horizontal. The claws are made in a core, in the same box which takes out the recess seen at the right of Fig. 9.

As drums are cast in diameters ranging from as low as 6 inches up to 8 feet or more, designs must be varied much in detail. In the larger kinds used for Titan and other big cranes, it is good practice to cast internal ribs, in order to avoid excessive weight of metal in the body. These sometimes have the form of one deep mid-rib only, running circularly, Fig. 10. Sometimes the rib is flanked with brackets or ribs run longitudinally from it to the end flanges; or the mid-rib is omitted, and longitudinals alone are cast, going from end to end, Fig. 11.

The main cores do not follow the grooves for the chain or rope, but are plain. To cast grooves in the cores would involve unnecessary work, and some risk of getting unequal thicknesses.

Full patterns are seldom made for helically grooved drums. There are exceptions in the case of the small drums, when these are required for standard use. Then the grooves are cut in wood patterns by the gouge of the patternmaker, aided by a templet, and working to screw lines around the body of the pattern. These lines are obtained either through points of intersection of equal divisions, circularly, and along the pitch, in the manner which applies to all screw formation, or by gluing a piece of paper around, having diagonals marked corresponding with the angle of the screw. A better way is to cut the pattern helix in a screw-cutting lathe, rigging up a gouge point in the slide-rest for the purpose, and finishing to the exact curve by a round-nose scraping tool, ground to the curvature, and kept well sharpened.

When the grooves are shallow for chain I have sometimes adopted another method, that of preparing pieces of wood, or very soft lead alloy, to the section, Fig. 12. These are then fitted round the plain body, the wood by saw-kerfing it, and the lead by bending it and setting it to a helix with a wooden mallet, and nailing or screwing it to the body. This is not so ready nor satisfactory a method as the other two, but it is an alternative of value in some instances.

When drums exceed about 18 inches in diameter, full patterns are seldom made. Up to about 3 feet 6 inches, or 4 feet, the molds are made from loam patterns; beyond that loam molds are swept. In each case a templet screw is used to sweep the grooves in the pattern, or in the loam mold, and right- and left-hand templets are required for striking them.

When deep grooves for chain like those in Fig. 5 are wanted, it is frequently better to use cores, Fig. 13, from a box like Fig. 14. This need not be done, however, if the grooves are made with well-tapered edges and good radii. But many drums are cored, and the prints are, in the case of small drums, fitted to the plain body

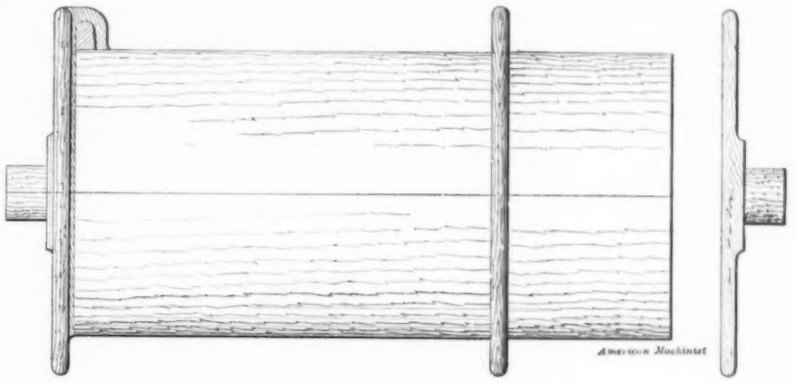


FIG. 2. PATTERN FOR LONG DRUMS.

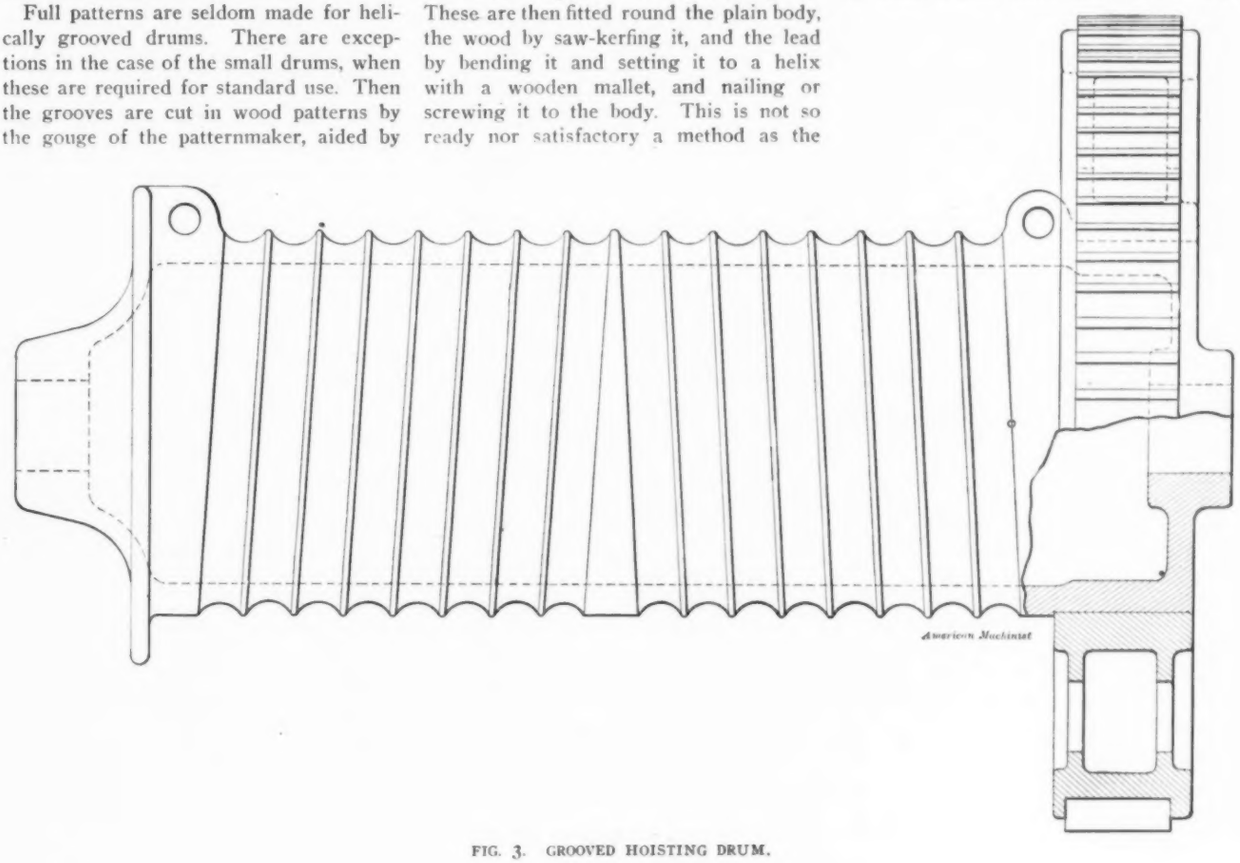


FIG. 3. GROOVED HOISTING DRUM.

and nailed on. In large drums they are swept up with a board similarly to grooves, a good taper being necessary to prevent broken edges.

A drum and its wheel or wheels are cast separately, in all but a few instances, and fastened together on their shaft. I have known drums cast on their shafts in small, cheap cranes, but this poor practice is unusual. A shaft and its drum are turned and bored to fit each other. The main wheel is keyed on the same shaft, generally close up to the drum, or keyed on the drum itself, the latter being the method adopted in most big cranes. Sometimes a wheel is bolted to the end of its drum, which is rather a more convenient mode of fitting large sizes than keying.

In Figs. 1 and 3, where a shaft is fitted in the bores at the drum ends, it is necessary to have different bores at each end for ease of driving or of thrust. If the holes were alike the entering end of the shaft would have to be driven through the first hole, a perfectly useless procedure. But by making the hole at the entering end ⅛ inch or so larger than that at the other, the force fit does not begin until both holes are being filled up simultaneously by the shaft. This is a matter of importance in fitting the feathers in the shaft, because the latter will have to be driven in and out several times during the operation.

It is necessary to have a good depth of boss for the shaft feathers to hold in. If there is not room enough to allow of making the outer bosses sufficiently thick, internal bosses are cast, as in Fig. 1. The keys used are of the feather type, sunk first into the shaft, and the latter is driven or forced into the barrel.

Fig. 3 illustrates a drum having provision for a main wheel keyed at one end. The object of such keying is chiefly to relieve the shaft of torsional stress and let the more rigid drum take the strain.

When drums are of considerable length, say, exceeding 3 or 4 feet, in the case of those for powerful cranes, it is better to equalize the turning stress by fitting two wheels, one at each end, and these are also fitted over the drum, properly with three equi-distant keys, among which the strain is divided. In attaching a pair of wheels, they should be set so that the teeth come alternately in relation to the horizontal, or on the "hit-and-miss" device.

The methods of attachment of ropes or chains to drums vary. A common device is that of a lug cast on the drum, Figs. 1, 3, 7, through which an eyebolt, seen in Fig. 1, passes, and is held with a nut, the eye receiving the first link of the chain. The latter is a little longer than the link of the chain to which it is attached, since it has to be welded into the eyebolt; and because of this fact, it is termed the "shutting link." Another device which avoids the excrescence of a rather large lug is to bolt an anchor eye, or hook, to one of the flanges to which the chain is attached. This anchor is also frequently bolted to the periphery of the drum itself when there are no flanges present.

Wire rope for small, light cranes can be anchored securely by the device of a tapered hole in a lug, the larger portion of the hole lying contrary to the pull of the rope. In this, the rope is made fast by a steel wedge driven through the middle of the rope after insertion into the hole.

In large drums it is necessary to anchor the rope in a lug, and this is best provided within the drum, the rope passing across and out through the opposite side, Fig. 15. An eye splice has to be made in the rope, and a thimble inserted to protect the rope from being chafed in its lug.

A practice which has been extending rapidly in recent years is that of cutting the helical grooves on some types of drums in the screw-cutting lathe without at-

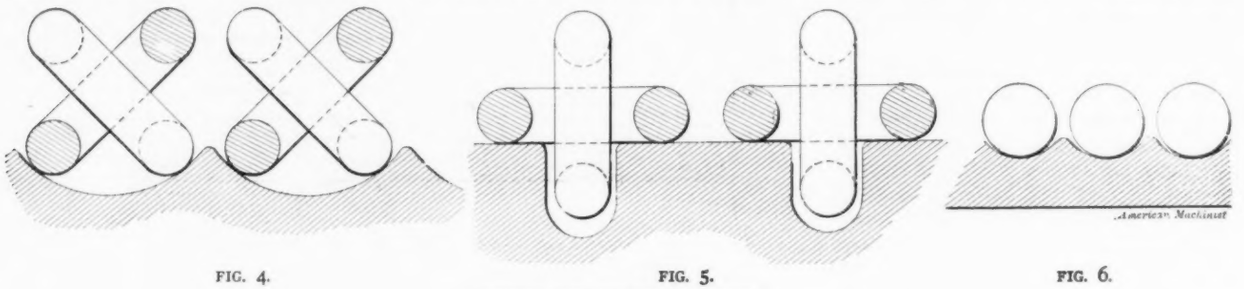


FIG. 4. FIG. 5. FIG. 6.

GROOVES FOR CHAIN AND ROPE.

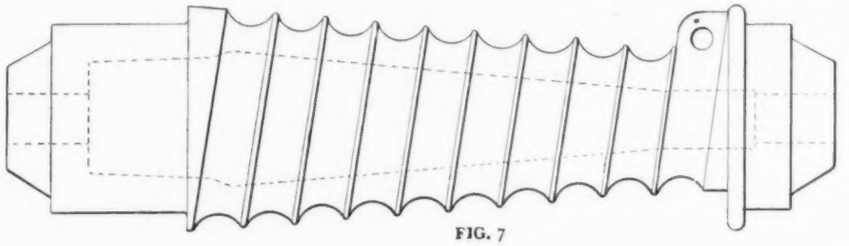


FIG. 7

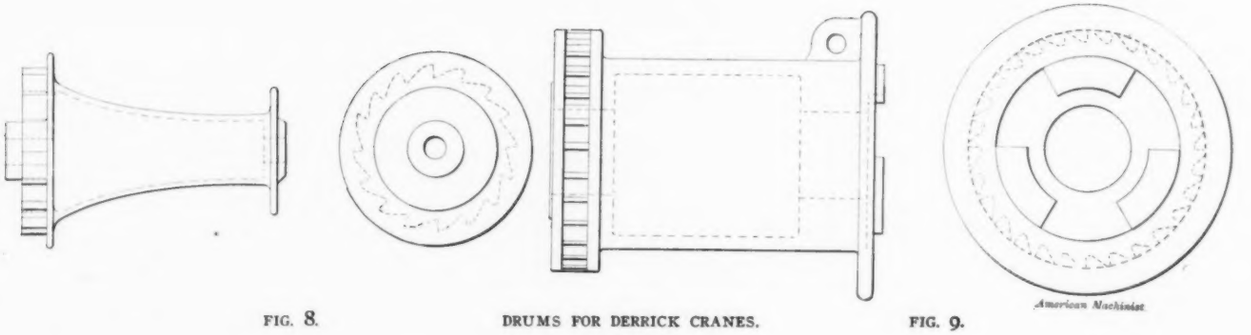


FIG. 8. DRUMS FOR DERRICK CRANES. FIG. 9.

tempting to cast the grooves at all. This is especially applicable to those drums having somewhat finely pitched grooves, so that there are a large number in a length of drum. It is necessary in high-speed winding to have the forms and pitch very accurate to lead the wire rope correctly. This is secured easily by the mechanical method of turning, cutting the recesses just as a screw would be done, using change gears to drive the slide rest. The tool may be of narrower shape than the grooves on commencement, finishing with another of the correct outline. The smoothness and accuracy of this mode of making helices is the reason why so many high-class cranes have their drums so finished in preference to casting.

[At pages 1010 and 1508, in the 1902 volume of the AMERICAN MACHINIST, and at pages 65 and 528 of the 1903 volume, can be found some further discussion of a few of the points referred to in the foregoing article, particularly the forms of grooves and methods of anchoring the hoisting chain.—ED.]

College Shop Experience—V.

BY HARRY MARQUETTE.

Back in the sixties, Squaw Gulch had been a prosperous placer-mining camp, but as the quartz ledges of the surrounding region and the lead carbonate and galena deposits of an adjoining range began to add their quota to the wealth of the region, the town grew in importance and in the esteem of its worthy citizens. They thought Squaw Gulch was not a sufficiently high-sounding name, and hence, after a long discussion, the town decided upon the Latin name for gold as a name for their city, and "Aurum" was painted upon the sign of the railroad station and over the leading hotel.

One of the most important factors in the fixing of the name for the town was the fact that it was to be dignified as the seat of the Territorial college, and must not its title reflect its educational character?

Great was the celebration which accompanied the opening of the college, but it was destined to be eclipsed by the celebration attending the proposed turning on of the electric lights for the first time in the streets of Aurum. The two newspapers, *The Squaw Gulch Miner* and *The Golden Eagle,* had forgotten their long and bitter fights in the past and joined issue to make this the greatest demonstration of the time. The plant was to be started and the lights turned on the city on a day in early June. There was to be a barbecue in the afternoon, horse-racing, exhibition riding, a roping tournament (lassoing) and the grand parade. The latter was to take place in the early evening, and wind up with appropriate speeches and the turning on of the lights when it got dark.

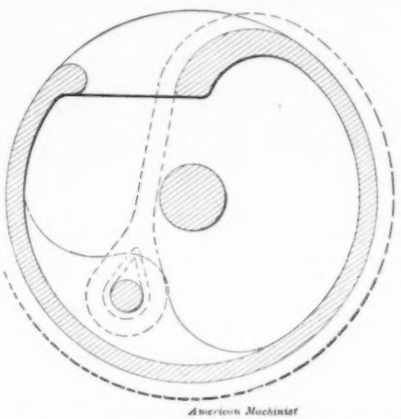


FIG. 15. ATTACHMENT OF THE HOISTING ROPE.

Mr. Rush, the mayor of the town, who stood high in the place as banker, financier and mine operator, was to make the principal speech and at its close turn on the lights.

The crowd which gathered was one which it would be difficult to duplicate in this day. There were the Cornish miners from the rival camps of Carbonate, Galena and Zozel, each led by its brass band. There were hundreds of cowboys on their ponies, who had come up from the ranges along the foot-hills. There were Indians in their blankets, and packers and freighters carrying their heavy whips. Conspicuous in the parade were the freight outfits from the mines, with their 12-mule teams, each pulling a train of four ore wagons. One old Indian fighter, who was now on good terms with the red men, had succeeded in persuading about fifty of them to join, and he rode at their head. There was a company of United States cavalry; there were the college cadets, headed by their drum corps, and the leading citizens in carriages. Even the Chinamen had caught the fever and brought a quantity of firecrackers. The sawmill gang from the mill down the Gulch were there, and the mine machinists, firemen and engineers from the three mining camps were marching in a body.

This motley array was finally assembled about the speaker's stand at the end of the main street, in a place where several vacant lots afforded ample standing room. The long line of poles extended down the street, each with its shaded incandescent light hanging from it.

After considerable speech-making by the college president, prominent mining men and others, Mayor Rush took the stand to deliver the final speech and turn on the lights. He started with the dawn of crea-

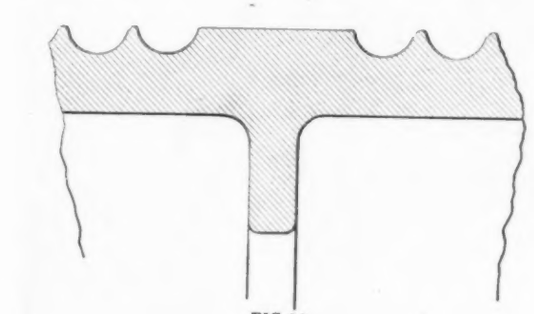


FIG. 10

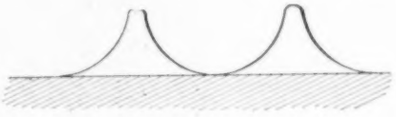


FIG. 12

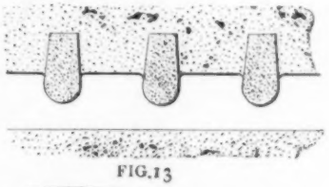
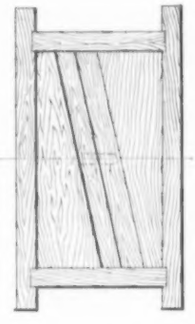
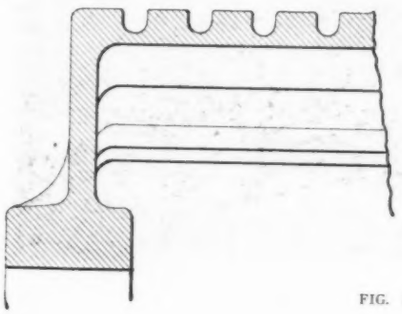


FIG. 13





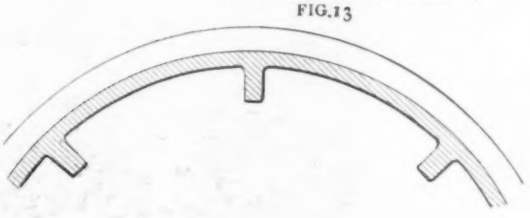


FIG. 11. FORMATION OF GROOVES IN CRANE DRUMS.

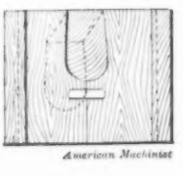


FIG. 14.

tion and described the progress of the universe, both before and since the advent of man. He pointed out the fact that among other endowments the Almighty had given man the ability even to create many things, and finally, as a climax, with a wide flourish of his arms, quoted with impressive emphasis:

"And he said, 'Let there be light,' and there *was*——"

At this point he pressed the button which was to turn on the lights, but no lights appeared. He repeated the operation, with the same flourish; *still* no lights. Three times he tried, and then even the loyalty of his townsmen could not keep the crowd from showing their huge delight at the joke; the gallery was let loose and whole volleys of good-natured banter were launched at the mayor. "Aw, where's the light?" "He's green at the creatin' business." "'Rah for the mayor!"

The mayor was a great man, but he was not proof against ridicule, and after his third attempt he slipped off the platform, sneaked home, and to this day, if anyone says to him, "Let there be light," he had better be well out of reach beforehand; for as time passes it seems only to make him more sore over the affair.

What had really happened was that the boys at the plant had started "Old Antediluvian" up so as to have it in readiness to take up the load when the mayor pressed the button; but "Old Ante" had gotten on one of its belt-slipping freaks and refused to work just at the all-important time, hence the mayor's embarrassing situation. It is needless to say that after that there were strained relations between the mayor and "His Nibs," and that even after the Easterner came to his senses, fixed up the dynamo right and got it running, there was still a lack of cordiality between the two men.

New Automatic Reversing Gear for Electrically-Driven Planers.

BY J. WILLIAM CHUBB.

Further evidence of the increased attention now being given in Great Britain to the driving of planing machines will be found in the system devised and patented by Vickers, Sons & Maxim, Ltd., Sheffield. The special equipment consists briefly of a variable-speed motor combined with special switches mounted on the planer and worked from the driving gear. The system has been on trial for some months in the workshops of the firm named, and, in fact, a 12x10x24-foot

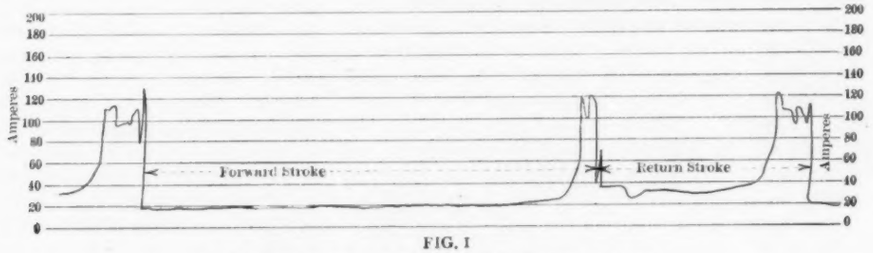


FIG. 1
CURRENT CONSUMPTION BY BELT-DRIVEN PLANER.

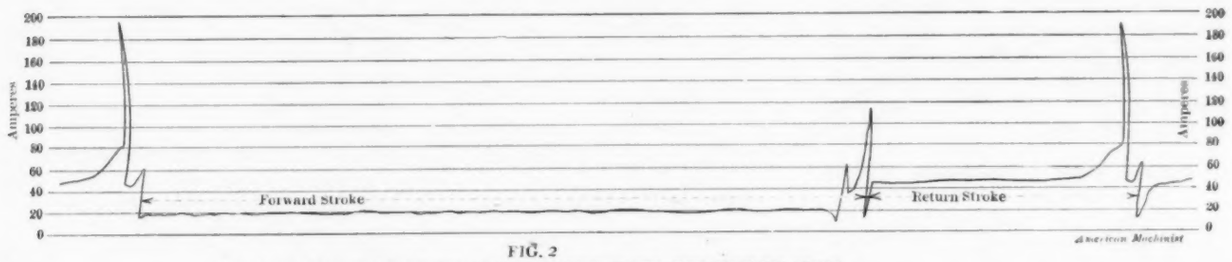


FIG. 2
CURRENT CONSUMPTION BY PLANER FITTED WITH THE VICKERS DRIVE.

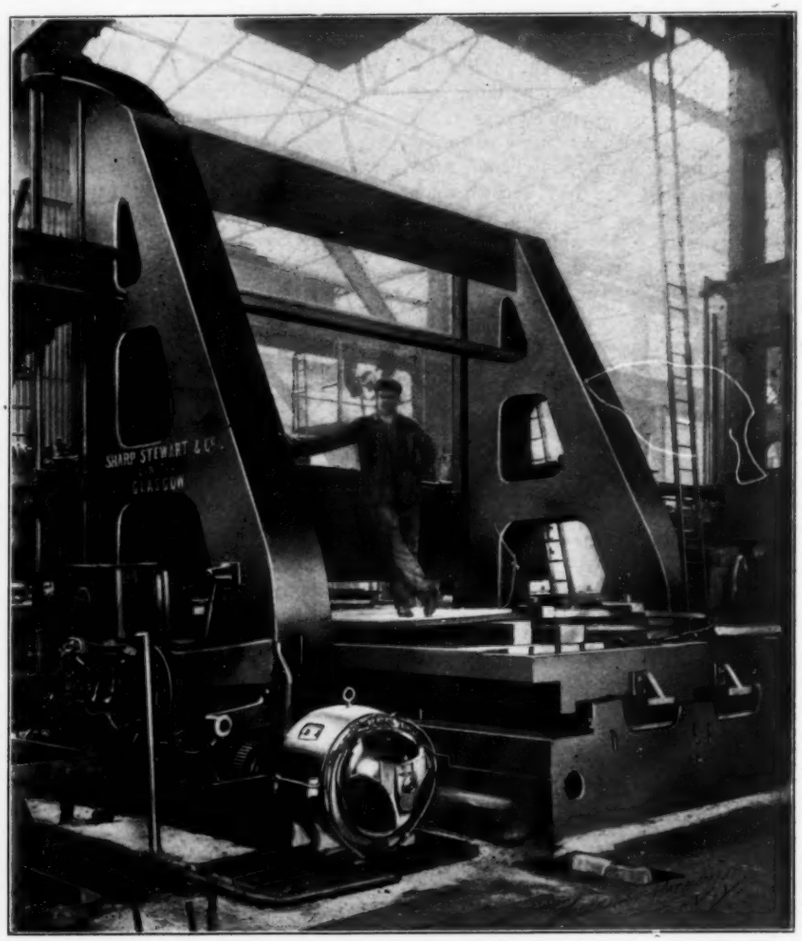


FIG. 4. PLANER USED WITH VICKERS DRIVE.

armor-plate planer, driven by a 20 horse-power variable speed reversing motor, was tried in operation for 24 hours a day during the working days of six months. On short-stroke work it frequently reversed more than 6,000 times a day, but at the end of six months the switches and motor were found not to have suffered in the least. In the end this firm decided to alter 16 large planing machines in their Sheffield works alone, and this conversion is now in progress.

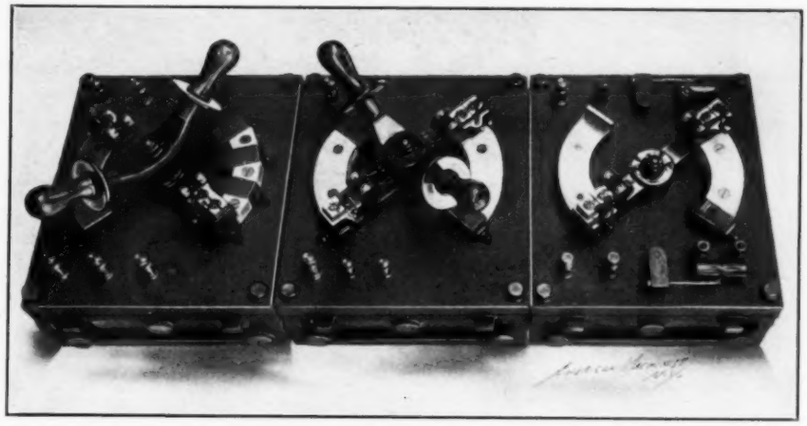


FIG. 3. SWITCHES FOR THE VICKERS PLANER DRIVE.

The chief points regarded as requiring remedy in the case of ordinary belt-driven planing machines are as follows: (1) The loss of time during the idle quick return stroke; (2) the loss of time during reversal through belt slip; (3) the waste of energy required to reverse driving pulleys and heavy belts; (4) the rapid wear of the belts and resultant high cost of repairs; and (5) the usually fixed speed of the cut. To overcome the first difficulty, planers have of course long been made to cut on both strokes, but there are certain cases in which this method of working is not applicable. With the Vickers gear there are no driving pulleys to reverse and the inertia of the driving system is much reduced, which permits quick reversal without the excessive waste of energy shown by a power diagram of the usual type of belt machines. As some evidence of this, Figs. 1 and 2 are offered, although the conditions of the two cases are not quite the same. The test illustrated by the first diagram was made on a Sharp-Stewart heavy planer, of 12x10x24 feet, which was belt-driven in the ordinary way by a 20 horse-power constant-speed motor. The travel was 14 feet 6 inches, the average rate of cutting 14 feet 6 inches a minute, and the average rate of the return stroke 32 feet a minute. In the second case the same planer was driven by a Vickers 20 horse-power variable-speed motor, in conjunction with the automatic reversing gear here described. The speed of the machine in the cutting stroke was 370 revolutions a minute, and on return stroke 1,000 revolutions a minute. The travel was 20 feet 6 inches, the average speed of cutting being 15 feet 5 inches a minute, and of the return 41 feet a minute. Despite the higher current rush at the end of the return stroke shown in Fig. 2, the difference of energy consumption will be plain.

The losses due to slip of belts and the expenses due to their wear and upkeep are entirely avoided, belts not being employed. As regards the cost of repairs to belts the firm state that, in their experience on large belt-driven machines, this has averaged from 30 to 40 pounds sterling a year, and in some cases has even reached 100 pounds. In fact, they consider this saving in cost of belting alone sufficient to warrant the conversion of the planers to the new method of drive. In the Vickers system the speed of cutting depends on the speed range of the electric motor, but between the limits of this range the cutting velocity can be varied instantly. This property greatly enhances the value of the machine, for the cutting speed can be changed at once to suit the material under treatment, from the hardest steel to the softest steel or wrought iron, with a consequently improved output from the planer. An instance is given of a planer in the Sheffield works having the slowest cutting speed of 15 feet a minute and a constant quick return at 60 feet a minute. In this machine the cut can be varied from 15 feet to 60 feet a minute by small intervals and without changing the speed of the return stroke, the alterations being made simply by turning a handle of the speed-controlling switch. The speed of the return stroke can also be varied in a similar manner

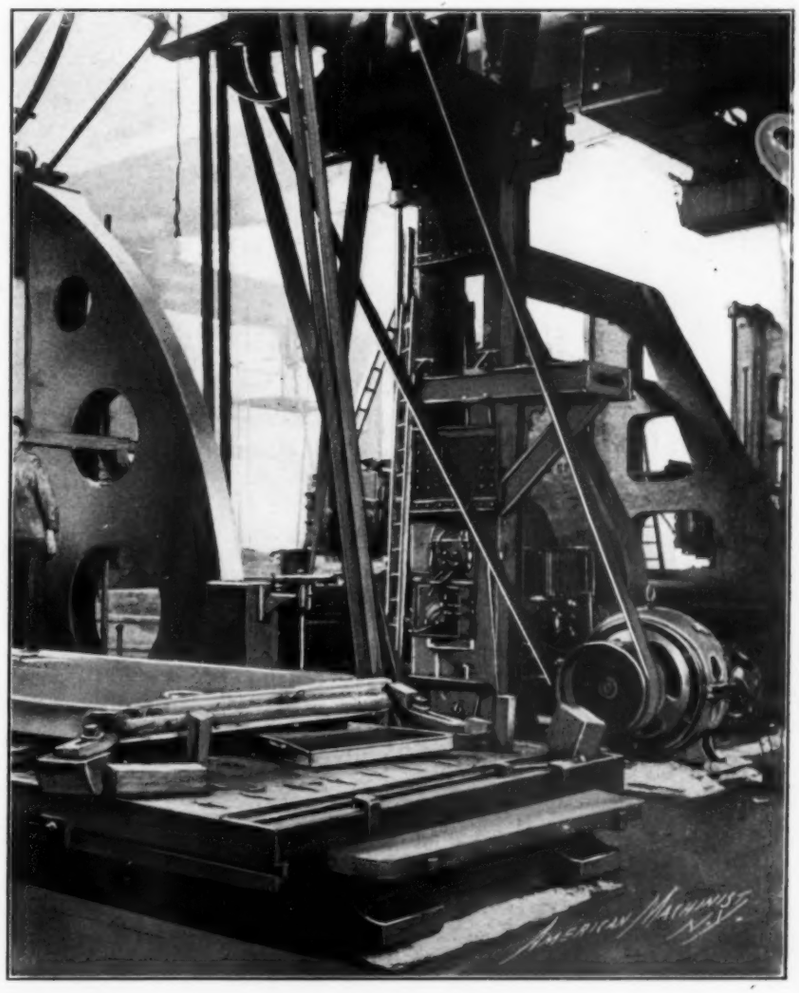


FIG. 5. BELT-DRIVEN PLANER.

if this is required. The tool will plane accurately to a line, provided the cutting speed is not greatly altered during the machining of the job.

Usually a shunt motor is employed, although the motor may be slightly compounded, the speed range being 3 to 1 or 4 to 1. The functions of the switches, Fig. 3, are (1) to start the motor from rest at the end of the stroke; (2) to insert or withdraw resistances in series with the field coils, thus altering the speed after reversal; (3) to reverse the armature connections and thus to reverse the direction of movement, and (4) to retard the armature at the end of the stroke by strengthening its field before reversal. Usually the planer is driven by a motor with a range of speed of from 300 to 900 revolutions a minute, the motor driving through spur or worm gearing. The motor reverses automatically at the end of the stroke, the length of which is of course adjustable, and directly after reversal the field is weakened, this causing an increase of speed depending on the value of the resistance inserted in the field circuit. At the end of the quick-return stroke, immediately before reversal, the field resistance is short-circuited, thus providing a strong field for reversal. It should be particularly noted that the speed variation is produced entirely by varying the shunt current, and it is distinctly stated that the efficiency of the motor is not less than 87 per cent. in any circumstances. As a further advantage of this method of drive it is claimed that a good deal of space and material can be saved, and to illustrate this Figs. 4 and 5 are given, the first of which shows the Vickers drive, while the second illustrates a planer driven by belt in the usual fashion. As regards cost, a large planer with motor and switches is very little, if at all, more expensive than the ordinary machine with belts and countershaft.

I. W. C.

Some New Designs of Friction Clutches.

The accompanying illustrations show three designs of friction clutches, recently patented by Ganz & Co., of Budapest. Friction clutches as hitherto constructed, which transmit power by means of spiral springs, only permit, when but a single spring is employed, of the rotation of the shaft in one direction. In the designs illustrated only one spring is employed, but this is so arranged that the shaft may be rotated in both directions.

In the form shown in Fig. 1 the clutch member *A* is turned conically internally, while the clutch member *B* is of cylindrical form. The spiral spring *C* bearing upon the periphery of the cylindrical clutch member *B* is conical upon its outer periphery, but is not rigidly connected to the member *B*. The two ends of the spiral spring rest against the stops *K N* formed on the clutch member *B* in such a manner that it is able to slide or become compressed or extended by the amount of play afforded by the stops. Between the inner face of the spiral spring and the outer cylindrical periphery of the clutch member *B* there is but very slight play. The clutch member *B* is displaceably mounted upon the shaft, but rotates with this latter, while the part *A* is mounted fast upon the shaft. By displacing the clutch member *B* in the left-hand direction the spiral spring comes into contact with the inner face of *A*, and friction is set up between the former and the clutch member *A*, so that both the spiral spring and the plate *B* are driven, the latter by means of the stops *K N*, according to the direction of rotation of *A*.

In the form shown in Fig. 2 both the clutch members *A* and *B* are cylindrically formed. Both parts are mounted fast upon their shaft ends to which they are keyed. In the inoperative condition of the clutch, the spiral spring *C* which is employed bears upon the plate *B*, so that there is an interval between the spiral spring and the member *A* of the clutch. As in the construction illustrated in Fig. 1, in this instance also the spiral spring is not brought into direct contact with the clutch member *B*, but by the intermediary of the stops *M* and *R*. The stops are not, however, as in the first case, made in one piece with the plate *B*, but are rotatably mounted upon the hub of this latter. By driving the wedge *S* between the stops *M* and *R* these latter extend the spiral spring in such a manner that it bears upon the member *A*, whereby friction is caused and the member *A*, drives the spiral spring so long (according to the direction of rotation) as the stops *M* or *R* reach the edges of the recesses *X Y* of the member *B*, whereby this latter is also driven. Upon the withdrawal of the wedge the friction ceases, so that the clutch is released. The coupling may also be effected in the present case by the spiral spring bearing when the wedge is out on the member *A*, while after the wedge has been driven in it bears upon the member *B*, so that the movements of the wedge are reversed for coupling and uncoupling.

In the form illustrated in Fig. 3 the clutch member *B* is displaceably mounted on the shaft, but rotates with this latter. The spiral spring *C* bears upon the plate *B*, and it may be extended either in the manner previously described or as shown in Fig. 3. In the latter case one extremity of the spiral is fixed by means of rivets *I* to the clutch member *B*, while its other extremity is in contact with a wedge by means of which it may be extended. In this form the power can only be transmitted in one direction of rotation. Between the plate *B* and the hub member B_1 to which the wedge *P* is attached a spring *O* is arranged. By the movement of the hub member B_1, for example, in a left-hand direction the members *B* and B_1

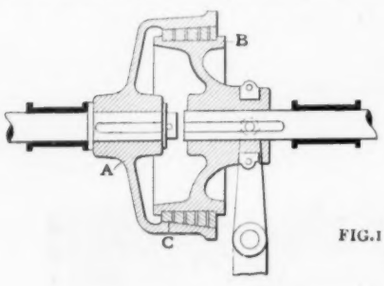
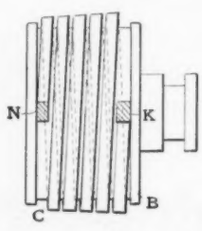


FIG. 1



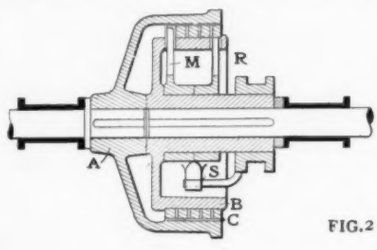
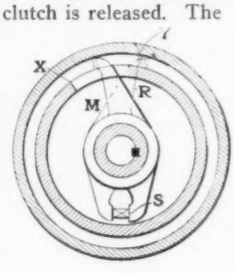


FIG. 2



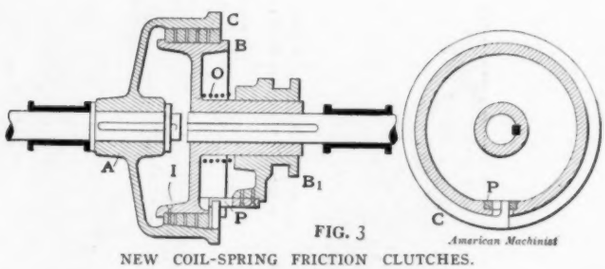


FIG. 3

American Machinist

NEW COIL-SPRING FRICTION CLUTCHES.

will be brought together until the spiral spring *C* and the member *A* come into contact with their conical friction faces, whereupon the member *B* is incapable of further displacement. After the wedge has quite extended the spirals complete coupling takes place. The purpose of this arrangement is to reduce the power required for producing the coupling to a minimum. In the form of clutch illustrated in Fig. 2 the spirals must be extended to such an extent that the interval between the spring and the member *A* is completely filled, and only after this can the power necessary to induce the friction be employed, while in this latter arrangement the spiral spring comes into contact with the member *A* even before the extension of the spirals is terminated. —*The Mechanical Engineer.*

Of the dutiable goods imported into Canada the United States furnishes 52 per cent. and Great Britain 30 per cent. When the preferential tariff in favor of British goods went into effect in 1894 these figures were 40 and 43 per cent., respectively. So far as percentage figures show the preferential tariff has failed of its object. It should be noted, however, that the British figures have been stationary since 1899.

Hydraulic Leathers.

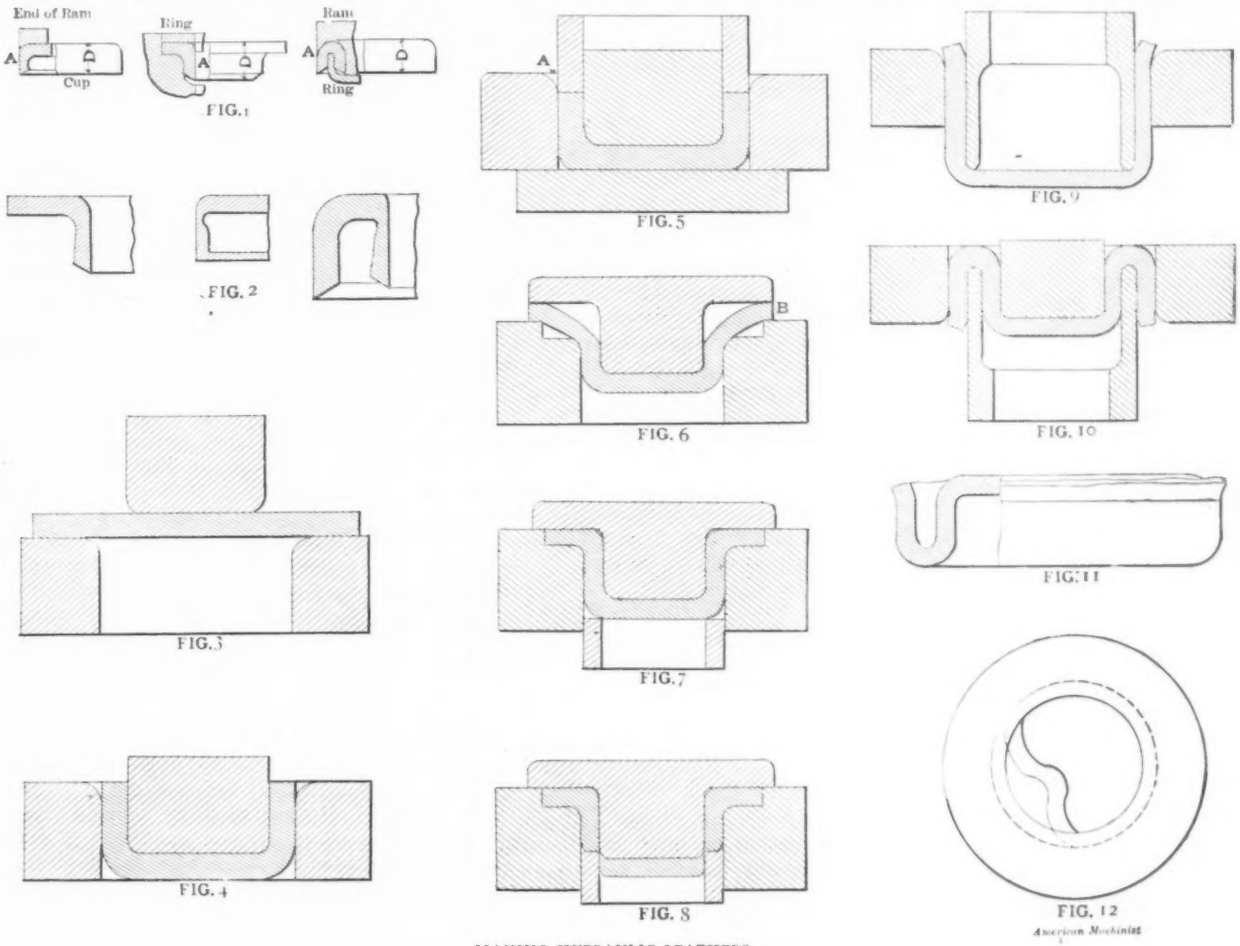
BY A HYDRAULIC ENGINEER.

Where high-pressure water is employed for power transmission, one of the most important and expensive items is the packing of rams, etc., so that they may slide backward and forward and yet be watertight. The higher the pressure the more important this question becomes; in fact, in many cases the limit to the pressure depends on the efficiency of the packing. There are many kinds of packing in use, each having its own special points, but there are many places in which the well-known self-acting leather packing is by far the best, if, indeed, it is not indispensable. Its chief disadvantage is, however, its initial cost, which, by the side of other packings, is high. Nowadays these leathers can be bought ready made, but there are many firms possessing hydraulic installations where the engineer in charge is expected to make his own, and where this is possible it is the better and cheaper method. This article is to describe the apparatus needed, the method of making, and a few hints for the successful working of the three kinds of self-acting leather packing; for although apparently a simple operation, the making of a good hydraulic leather needs considerable practice and care. The three kinds are shown in Fig. 1.

To all who have studied hydraulic machinery it is a well-known fact that the depth *D* of the leather has practically no effect on its watertightness and friction, as the joint is made at one place only in its depth—*i. e.*, the point *A* in each case. This fact is clearly shown in Fig. 2, which shows sections of the three kinds of leathers which are worn out. As will be noticed later, the part *A* which shows most wear is also the part which receives most stress during manufacture. Also, the deeper the leather the greater the stress at this point, and the more care is needed in the manufacture to retain an even thickness throughout the finished leather, so that it is evidently advisable, and certainly cheaper, to keep the depth of the leather as small as possible.

A leather should exactly fit the recess made for it, except in the depth, and where possible should be fitted with a guard ring for it to bed against, rounded out to exactly the same curve as the leather (Fig. 1).

In the case of the U leather the guard ring is very necessary, and should have holes drilled in it to allow the water to get to the leather. The distorted shape of the U leather shown in Fig. 2 is due to the fact that no guard ring was fitted.



MAKING HYDRAULIC LEATHERS.

Attention to these details results in the leather keeping its shape much longer than it would otherwise, and consequently it will last longer; also, the leather opens out more quickly when the pressure is first put on.

THE SELECTION AND PREPARATION OF LEATHER.

Leather specially prepared for the purpose is sold by the curriers. It is softer than ordinary leather, but should be of the very best quality; a piece from "middles" is best. The procedure is then as follows: Select a sound piece the required diameter, free from "knots"; look especially for "pin pricks," which open out and show better when the leather is wet and stretched. If one of these fine holes is found, lay the piece aside for a smaller size, because the hole is sure to open out during the manufacture, and when finished the leather will be porous. When a sound piece has been selected, pare off with a knife all the soft part on the flesh side, and make the leather blank an even thickness all over, and from 3-16 to 5-16 inch, according to the size of the leather. Be careful to measure from the molds *exactly* what the thickness is, as great trouble is experienced in "blocking" the leather if too thick. Now soak the blank well in water, working it between the thumb and fingers until it is soft and pliable all over; rub tallow well into it, and it is then ready for the molds. Great diversity of opinion exists as to which is the better side of the hide for the wearing surface, whether the smooth hair side or the rough flesh side The hair side is closer grained, and therefore more waterproof than the flesh side. Thus, if the hair side be put inside, and the flesh side for the wearing side, the leather will be waterproof almost as long as it lasts. On the other hand, if the hair side is put to the wearing side, the leather will wear better, and has a much neater appearance. The writer, however, has always found it best to put the smooth side inside, and let the rough side take the wear.

CUP LEATHERS.

These are not often used for rams exceeding 3 inches diameter, and should vary in depth from 3/8 inch for 1 inch diameter and less, up to about 5/8 inch for a 3-inch leather. Place the prepared blank, smooth side upward, centrally on the die, and punch centrally above, as shown in Fig. 3. Then force the punch in, gradually and at intervals, until the leather is just level with the bottom of the die; trim off the top edge so that it is just level with the die top. Now force the leather a bit farther through the die, and insert the ring, as in Fig. 5. This saves the ring from spraying the leather at the round *A*, Fig. 5. Put the plate on the bottom and force the ring in a little way. Draw or knock the die down to the plate, and clamp it in this position (Fig. 5). Remove the clamped mold and leather and put them in some warm place, such as a boiler-room, or the top of a steam-engine cylinder for small sizes, and leave to dry. This usually takes from a few hours to a day, according to the size of the leather. Take care that the place is not too hot, or it will seriously deteriorate the leather. When taken from the mold the leather should have set quite hard; in fact, the better the leather the harder will it set. The bevel edge can now be put on with an ordinary knife, and smoothed round with fine glass paper. The leather is then finished. This bevel should be at about 30 degrees, and it is very important that it should continue right up to the edge of the leather, leaving a sharp edge all the way round. Table 1 gives the diameter of the blanks from which to block the leather.

	in	in.	in.	in	in.	in.	in.	in.
Outside diameter of finished leather,	3	2 3/4	2	1 3/4	1 1/4	1	3/4	
Diameter of blank	4 1/4	3 3/4	3 1/4	2 1/2	2 1/8	1 7/8	1 3/8	

TABLE 1. BLANKS FOR CUP LEATHERS.

HAT LEATHERS.

Like cup leathers, these are seldom used for rams exceeding 3 inches in diameter. The total depth should vary from 1/2 to 3/4 inch. The various stages in the manufacture are as follows; First, with the rough side upward (Fig. 6), force into the dies as much as possible of the part *B;* the remainder will be sheared off by the sharp edge. Insert the ring as in Fig. 7 and punch the bottom out. Force the ring in a bit, and clamp in this position (Fig. 8). It can then be dried and finished off the same as the cup leather. The same ring that was used for the cup leather will answer. Table 2 gives the diameter of the blanks from which to make the leathers.

	in	in.	in.	in	in.	in.	in.	in.
Inside diameter of finished leather	2 3/4	2 1/4	1 3/4	1 1/2	1	1	3/4	1/2
Outside diameter of finished leather	3 3/8	3 1/8	2 7/8	2 5/8	2 1/8	1 5/8	1 7/16	1 1/8
Diameter of blank	5	4 5/8	4	3 5/8	3	2 3/8	2 1/4	2

TABLE 2. BLANKS FOR HAT LEATHERS.

U LEATHERS.

This is by far the most common form of leather. It is superior as a packing to the cup or hat leather, and also has less friction, being more supple; but it is more expensive and needs more care in its manufacture, and hence, where possible, the hat or cup leather is used. The U leather can be used for any size ram from 1 inch diameter upward. The depth of U leathers is as follows:

For rams up to 1 1/4 in. diameter, 1/2 in. deep.
" above 1 1/4 in. and up to 3 in. diam., 5/8 in. deep.
" " 3 in. " 20 in. " 3/4 in. deep.
" " 20 in., from 1 to 1 1/2 in. deep.

The manufacture is explained by the sketches, Fig. 9 showing the first position, with the smooth side of the leather inside. Leave it in this position from about half an hour to a few hours, according to the size of the leather; then invert, put in the center block, and force the middle portion out again, as shown in Fig. 10. Let it dry in this position. Then take it out of the mold and scribe a line on the side all way round, with a scribing block, showing the depth of the leather (Fig. 11). Now fix in a vise, and, with an ordinary wood saw, saw off by this mark, and finish off flat by rubbing on a piece of glass paper laid on a flat table. The bevel edge can now be put on and finished off with sandpaper as before. The following plan is recommended if a large number are to be made. When the leather has dried, take it out of the mold and fasten it to a wooden faceplate of a small lathe. The required depth is then soon cut off with a wood-turning chisel, and the bevel put on, and polished. The burnished appearance which some makers' leathers have is put on in the lathe by means of a hard-wood stick and soft soap; but, of course, this only improves the appearance and not the quality of the packing. Table 3 gives the diameter of the blanks from which to make the leathers.

Inside diameter of finished leather, in.	18	14 1/2	11	8 1/2	8	7	6	4 1/2	3 1/2	3 1/2	2 1/2	2	1 1/2	1
Outside diameter of finished leather, in.	19 1/2	16	12 1/2	10	9 1/2	8 1/2	7 1/2	6	5	4 1/2	3 1/2	3 1/2	2 1/2	2
Diameter of blank, in.	25 1/2	20	16 1/2	14	13 1/2	12 1/2	11	9 1/2	8	7 1/2	6 1/2	5 1/2	4 1/2	3 1/2

TABLE 3. BLANKS FOR U LEATHERS.

In all the operations great care should be taken that all the dies and the blanks are central, so that no part is unduly stretched. Always use a disk of leather, and never attempt to block a leather from a washer, because the middle cut out of the finished leather can always be used for smaller sizes, so that no leather need be wasted. With regard to exerting the pressure, the practice of cutting a hole in the center of the blank and drawing the punch down with one central nut and bolt is not recommended, as the leather invariably draws away from the hole, and in many cases tears; and, again the hole cut is often bigger than that needed in the finished leather. If a great many leathers are to be made, a small hydraulic press is very useful, but usually the quantity to be made does not warrant such an expenditure. For the smaller sizes up to about 2 inches the ordinary bench vise is all that is needed. For the larger sizes a bench fitted with two slots (at right angles to each other) to take 1-inch tee-headed bolts, a few clamps and tee-headed bolts are all that are needed; the clamps, of course, are used in the usual way. The writer has used this simple tackle for "U" leathers 26 inches diameter and 1 3/8 inches deep.

RE-LEATHERING A MACHINE.

Always keep the full number of spare leathers in stock, and as soon as one is used, make another to replace it. This is economy, because a leather when made up does not deteriorate like the raw hide. It also saves much inconvenience if a leather should give way unexpectedly. Before placing a leather in a machine, take the leather and rub it well with good dubbin or the best tallow, until it is soft; neats-

foot oil is very good, but it is expensive. If it refuses to soften and still remains hard, put it in warm water for a few minutes; but if this is done, it must be put into the machine immediately, or it will swell out of shape and have to go into the mold again. The same applies when cleaning a machine, and if a leather is taken out wet it should be at once put into a mold, for if allowed to dry out of the machine it will be found impossible to get it into the machine again. Always measure the depth of the recess which is to contain the leather, and also the depth of the leather, to see there is plenty of play depthways, for if a leather is nipped in the depth it prevents it from opening out under the water pressure. Also be careful that the bevel is on. This seems a small point, but it is very important and often overlooked. The writer remembers, out of many cases, one of recent date in which a hydraulic machine had been re-leathered by the engineer in charge, after which the machine refused to work. A mechanic was brought from the firm where the machine was made (about seventy miles away), and he found that leathers without a bevel had been put in. The bevel was put on, and the leather put back. The machine then worked as well as ever.

The only difficulty experienced in inserting a new leather is in the case of a U leather, when the mouth of the cylinder is not fitted with a gland, but has simply a recess turned in it. If the leather is of large diameter its own springiness allows it to be pushed in, if done gradually and with care. If of small diameter, as much as possible must be pushed into the recess, and then with a hammer shaft the remaining portion is knocked straight down. It will appear as in Fig. 12, and can then easily be pressed into the recess; but the leather must not be too soft, or this method will make it very much out of shape.

When in use keep the ram bright and well lubricated. If possible the part of the cylinder that the leather works over, or the part of the ram that works over the leather, should be sheathed with brass or, as in more modern practice, copper; the leathers last much longer and need less lubrication. When working against gray-iron and the lubrication is poor, the leather seems to actually tear away small portions of the iron from the surface. Even with slow motion, when the pressure is high, as in a flanging or stamping press, this is quite apparent, for if a well-worn leather is removed and allowed to dry, small specks of iron, quite visible to the naked eye, are seen to be embedded in the working face of the leather. Finally, always use water as clean and free from grit as possible.—*The Mechanical World.*

By the bursting of a fly-wheel, on September 1, at the National Tube Company, McKeesport, Pa., four men were killed and several seriously injured.

Sheave Wheel Molding.

BY R. DAVIS.

In up-to-date foundries the foremen try to avoid cores and three-parted work as much as possible, as they are rather expensive; I shall, therefore, endeavor to show how their use is nowadays avoided by progressive foundrymen in making sheave wheels.

Of the various forms of sheave wheels some are made with the grooves adapted for chain and others are made for cable, some have a web which connects the rim with the hub, while in others this function is performed by spokes. I will in this article show the three kinds and how they should be prepared for molding.

CASE 1.—WEBBED WHEEL WITH PLAIN GROOVE.

Where the sheave has a web instead of spokes and the rim is for rope or cable, then the usual three-parted job should be turned into a two-parted job by mounting the patterns as follows:

A master pattern should be made as shown in Fig. 1, a little over half of this master pattern being made solid—that is, with a web instead of spokes—and attached to this web in the center of the pattern is the hub; the remainder of this pattern is made with spokes, see Fig 1. The hub is large enough to allow for drilling in the center a hole for the center shaft, the size of the shaft to be the same as the core print. The necessary number of good brass castings should be made for patterns, and turned up on a mandrel to the proper size and shape; after turning saw the spoked portion away from the webbed portion and dress up the sawed surfaces; then the patterns are in proper shape for mounting. A shaft is gotten out to the size of the holes in center of the patterns, and long enough to take in all the patterns that are to go in one line, as well as to rest in bearings at the ends of the plate; the patterns are securely fastened to this shaft, so that when the shaft is turned the patterns will also turn. A flat plate should now be made of such a size that the flask to be used can rest on the top of it close to the edge; this plate is made so that when the top surface is planed true the metal will be about 3-16 inch thick in the middle; at the places where the patterns are to be cut through the outer edges of the plate can be 1¼ inches thick to strengthen it. Lay out on the top face of this finished plate the desired location of the string of patterns, and cut an opening through the plate to the size of the shaft the patterns are mounted on. If the end of the shaft crosses the thicker metal on the outer edges of the plate, then at this point make the opening in the plate to the shape of one-half of the shaft, then set the shaft carrying the patterns in the openings till the flat surfaces of the patterns rest on the top of the plate, and while they are in this position take a scriber and scribe the outline of each pattern on the top face of the plate—a little copperas rubbed on the plate before scribing it will cause these lines to show up more plainly, and all the metal within the scribed outline is to be cut out to enable the patterns to just slip into their centers so that turning the shaft will cause them to turn through the plate. At the ends of the shaft are fastened bearing caps to prevent the shaft from lifting up. Midway of the length of the pattern shaft is located another bearing on the under side of the plate to support the shaft when the sand is being rammed in the flask; this bearing need not be very wide, so as not to interfere with the patterns setting close to one another on the shaft. There can be several lines of shafts with patterns mounted in this fashion, all the shafts being connected to one another by cranks or small gears. When these patterns are properly mounted they will project above the top of the pattern plate just one-half the diameter of the pattern and the shaft will also project a distance equal to its radius. The shaft acts as the core print, as well as a turning device to the patterns; it also makes a nice vent for the mold.

MOLDING.

To make a mold off this plate of patterns the patterns are turned up through the plate and a locking pin is set through one end of the shaft and a bearing not previously mentioned, then the drag section of the flask is set on the plate, the plate having flask-pin ears cast on the end of it, which ears are drilled to fit the pins in the end of the flask. The flask is then filled up with sand and rammed in the usual way, the locking pin is removed and by means of the crank fastened to the shaft the line of patterns are simultaneously turned out of the mold, leaving a perfect print of them in the sand. The flask and sand are then removed from the plate and the cope put on and rammed in a similar way, removed and set on the drag, a pouring hole being cut in the top of the cope before removing the patterns from the sand. This makes a very nice method for molding this kind of sheave wheel and turns them out very uniform. Trolley wheels are also made in a similar fashion.

CASE 2.—SPOKE WHEEL WITH PLAIN GROOVE.

Where the sheave wheel has spokes, as shown in Fig. 2, instead of a web, and the groove is made for rope or cable, the following is the method to be pursued to avoid a three-parted flask:

The master pattern is made to the shape of the desired sheave; as the pattern is split in the center of the groove it is necessary for two master patterns, one of each half, to be made. As a general rule this style sheave, such as is shown in the drawings, is made for large work such as elevator work, and is then about 10 inches in diameter; the hub protrudes up

from the center of the sheave proper to suit the construction of other parts of the elevator work. On the parting line in the center of the groove portion of the pattern are four small ell pieces which fit in similar shaped pockets in the opposite half of the pattern. Openings are made so that all four of the ell pieces will enter the pattern, allowing the two patterns to come together, then by a turn of the section to which the ell pieces are fixed the two patterns are securely locked together. A brass ring should now be made that will be large enough to encircle the pattern, and have about 1½ inches clearance all around between it and the pattern; this ring is to be held in place by four connecting pieces which are attached to the top spoked section of the pattern and to the brass ring. The sides of the ring are to have considerable draft. The parting line of this job (see Fig. 3) is along the surface *G* down to the split in the center of the groove, then inward and along the under side of the spokes to the center hub *F* and along the under side of the hub *F* to the center of the pattern; this brings all the spokes *B* and the hub *F* in the cope, while the remainder which includes the ring and the half-rim *A*, and the green sand core, will come in the drag. A plaster or litharge match is then made to match the cope section of the pattern.

MOLDING.

To make a mold put on the drag section of the flask, fill up the green sand core ring with sand and ram it in tight, scrape off the surplus till the top is flush with the top of the ring. While this ramming is being done the section *A* is securely held in place by the four ell pieces; if it were not so held down it is plain to see that it might lift up and make an imperfect mold. A little parting sand is sprinkled on the face of the sand in the sand frame and then the whole drag is filled up with sand and rammed in the usual way; a bottom board is then placed on top of the drag and the mold is turned over. We now make the cope: The match is lifted off and the cope flask set on, the sprue is set in place on the core print, which is provided with three feeders running from top to bottom along the tapering sides. Then fill up the cope with heaped sand and ram in the usual way, then vent it; set another bottom board on the cope and turn the mold over, lift off the drag and turn the half-rim pattern *A* and lift it off the section *B*, then set the drag back on the cope and turn the mold over again, setting it on the bottom board. Draw the sprue and lift off the cope, then draw the pattern *B* and the sand frame out of the mold and shut off the opening between the pattern and the sand frame, which can be done by merely pushing the sand into the cavity; while it will not look the finest, yet it will block the flow of iron where not desired. Set the cope back in place on the drag, and you will

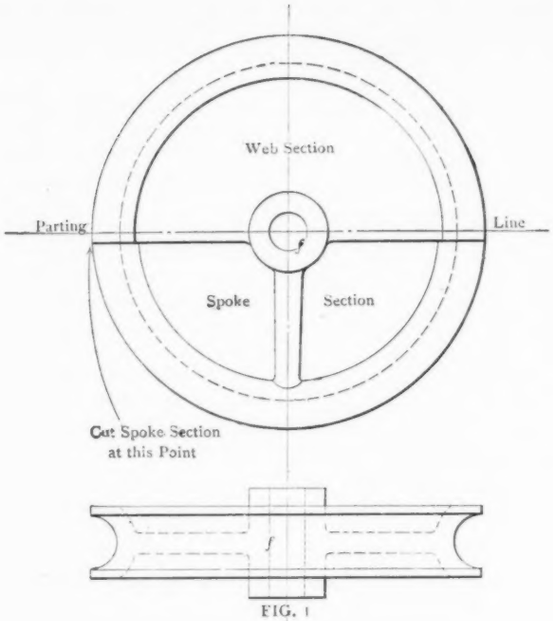


FIG. 1

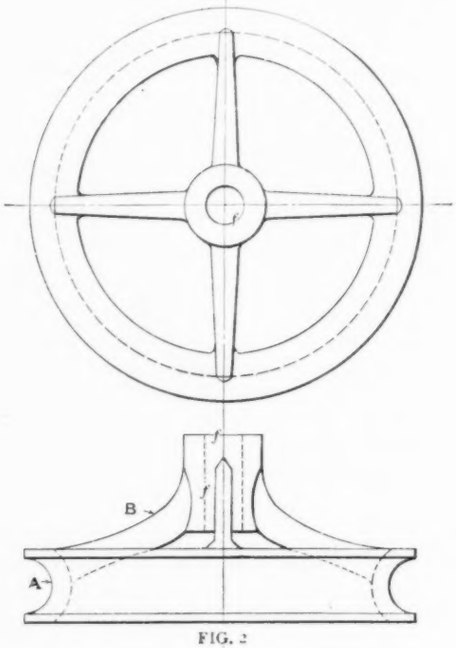


FIG. 2

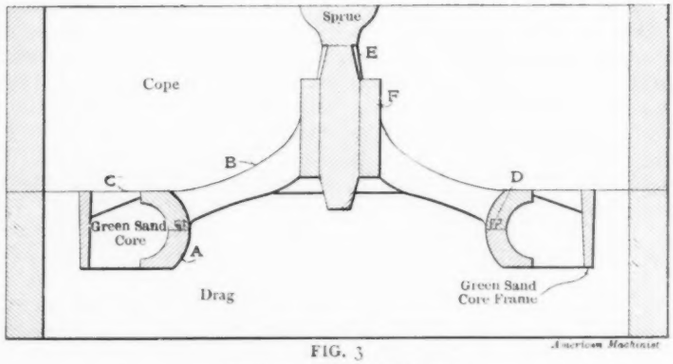


FIG. 3

SHEAVE WHEEL MOLDING.

have a mold that generally requires a cheek section and a three-parted flask now made in a two-parted flask, with a green sand core resting in the drag section of the mold. This is a very neat way of making the job; and the molds can be made very rapidly when the molder gets used to the new movements; this method of making the job also saves the handling of the sand that is contained in the cheek section of a three-parted mold; this sand question alone is quite an item in a day's work, which fact will be appreciated more by the molder than by anybody else.

CASE 3.—WHEEL WITH TOOTHED GROOVE FOR CHAIN.

Where the sheave wheel has teeth in the groove to be used with chain, then the three-parted flask is avoided by mounting the patterns as follows:

A master pattern of two parts is made similar to that in Case 2, the patterns split in the middle of the groove, but instead of the small pattern section being turned free from the rest of the pattern, it is fastened to a brass ring in a fashion similar to that of the spoked section of pattern in Case 2. The top section of the sheave wheel is held in position centrally with the lower half of the wheel by means of a center stud; and where the pattern has a core print, the print is made square so as to prevent the sheave from turning; the print is fastened to the section of the pattern to which is fastened the brass ring; the other section of the pattern has a square hole in its center to fit the square of the core print. This long stud will be useful in two ways—first, in keeping the pattern from turning around in the mold and tearing it up at the teeth in the groove; second, it acts as a steadying pin when drawing the top section of the pattern from the sand, thus insuring a perfect mold for that section. The sand frames, which act as a green-sand corebox and which surround the pattern, are connected to one another, and a main gate is run in between them, as is done in regular gated work, then the sand frames are connected to the central gate, and this gate in turn is fastened to an aluminum frame.

MOLDING.

In making the mold, the patterns can set on a wood board or a litharge match, the sand frames around each pattern being filled up with sand and rammed tight for molding or pouring purposes, and the surplus on the top surface is scraped off flush with the top of the sand frames; then this sand surface is sprinkled with parting sand and the drag section of the flask is then placed in position over the whole job. The drag is filled up with heaped sand and rammed as in Case 2; a board is placed on it and the mold is turned over, and the match or follow-board is lifted off. The exposed surface of the sand is then sprinkled with parting sand and the cope section of the mold is placed on the drag and filled up with heaped sand and rammed in the usual way; a sprue hole is then cut in the cope down to the center gate of the patterns; then the cope is lifted off and the cope section of the pattern is drawn out of the sand. The cope is placed back on the drag and the mold turned over again, and the drag section of the mold is lifted off the cope. Then the drag section of the patterns is withdrawn from the sand by means of the aluminum frame, which has handles on the sides of it for this purpose. The cavity made by the main gate on each end is stopped off to prevent the iron from running out of the mold and where not desired; this leaves the remainder of the gate to run the mold. The patterns proper are connected to the rings or sand frames by two leaders, which act for the double purpose of holding the ring in its place and allowing the iron to get into the mold.

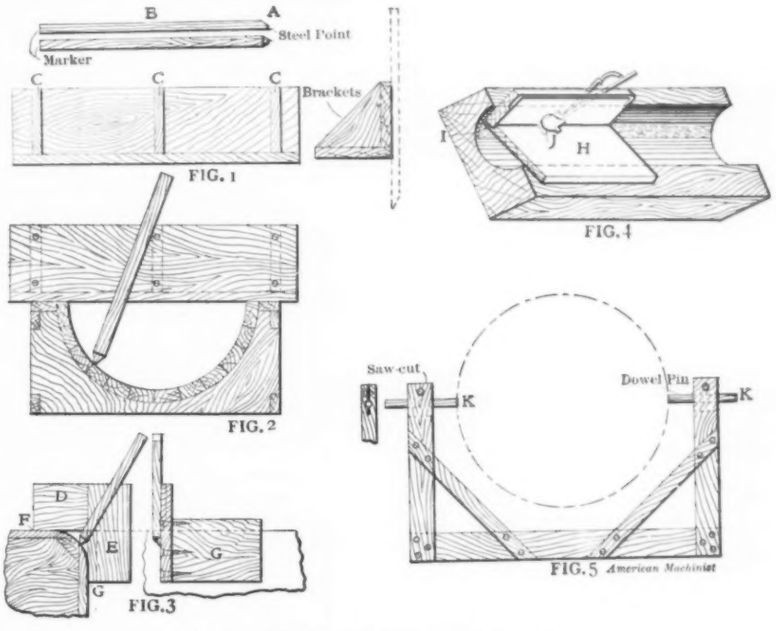
It will be seen that by this method this type of sheave wheel can be made in a two-parted flask, without the aid of a cheek flask, and also without the aid of a dry-sand core. The expense of equipment for making sheave wheels as I have outlined is not very great, and in a short time it will pay for itself by the quantity and quality of the work.

Since work was resumed in the shipyards and engine shops of the Clyde after the "Fair Holidays," great briskness has prevailed in the output of new tonnage, and the aggregate for August promises to show a record month's work, thanks to the quota represented by one vessel alone, the P. and O. "Mooltan," of 10,000 tons gross register, and by five other vessels, each of over 5,000 tons.—*The Engineer.*

Letters to the Editor.

Handy Devices for the Pattern Shop.

The accompanying illustrations show what is usually termed a vertical plumb or box-square. It is a handy device which will be found very convenient in transferring lines to irregular surfaces which do not lend themselves readily to the use of a square or even a flexible rule. The device consists of a box-square made of wood, as shown in Fig. 1. The marker consists of a straight piece of hard wood, shown in the upper part of Fig. 1, and in dotted lines at the right-hand side. This marker has a brad driven in the end and filed to a point as shown at *A*, or a metal plate let in flush with the face of marker and filed to a point; care should be taken to see that the point is in exact line with the face *B*. One instance of the use of the device is for drawing a line across a core-box, as shown in Fig. 2; it will also be found very convenient for pipe connections, stove work, etc.



HANDY DEVICES FOR THE PATTERN SHOP.

Fig. 3 shows the application of a little different form of the box-square for external work. The square shown in Fig. 1 cannot readily be adapted for this class of work on account of the brackets *C*. The form shown in Fig. 3 receives the necessary stiffening from the faces *D* and *E*, which are halved together and attached to the faces *F* and *G*, as shown.

Fig. 4 shows a method of converting a rabbet plane into a core-box plane. The wing *H* should be twice as wide as the body of the plane, and should be attached by screws at a right angle to it, the face of the wing being allowed to project slightly beyond sole of plane at *I*, so that it will come opposite the cutting edge of the bit. The wing should be gouged out

opposite the throat *J* of plane to allow the shavings to clear themselves fully.

For calipering large work it is frequently difficult to obtain a pair of calipers large enough which will at the same time be delicate enough. Large metal calipers are very heavy and awkward, and hence not as delicate as might be desired. Fig. 5 shows a light wooden-frame caliper made up of strips screwed together and provided with adjustable pins *K*, made from the ordinary dowel-pin stock.

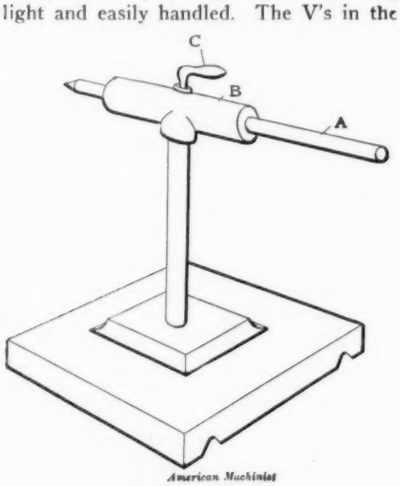
THOS. MACK.

Cleveland, Ohio.

A Center Indicator for a Chucking Lathe.

Recently, while in the die shop of J. H. Williams & Co., Brooklyn, I saw the indicator shown in the sketch. It was used to facilitate setting work in the chuck or on the face-plate of a chucking lathe.

While the lathe upon which it was used had no tailstock, it would, I think, be a handy accessory to any large lathe, being light and easily handled. The V's in the



A CENTER INDICATOR.

base fit the V's on the bed. The center is a parallel steel bar sliding in *B*, which is bored in line with the lathe spindle. The handle *C* clamps *A*.

DIXIE.

Press Tools for Small Armature Disks.

In the sketches shown, I illustrate and describe a successful die for small armature disks. These disks are for a massage motor such as is used by barbers, doctors, and nurses for the treatment of the skin. The motor assembled complete weighs less than 2 pounds, and is held in the hand by the operator. An eccentric on one end of the shaft throws it out of balance, which gives the other end of the motor frame a vibrating movement, this being transmitted to the different pads and rubbers that are used.

Fig. 1 shows the disk, Fig. 2 the punch and stripper, Fig. 3 the die. In machining this die, I turned a piece of tool steel to fit the spindle of the universal index head, then put a chuck in the milling-machine spindle containing a drill and drilled six 3-16 inch holes in. The knee of the milling machine was then raised and six ⅛-inch holes were drilled, these holes corresponding to the ends of the slots shown in Fig. 1. The opening at the top of the slots was then milled, this being 3-32 inch wide, at the same setting. Two pieces were then cut off, one being for the die and the other for a holder for the punches. The slots were now finished by filing, then hardened. After being hardened, the die was ground and inserted in the tool-steel ring *A*, Fig. 3. This ring makes a cutting edge for the punches at the end of the slots and also contains two holes, one of

FIG. 1

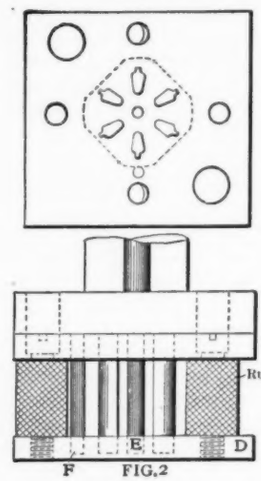
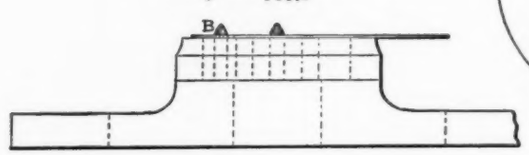


FIG. 2



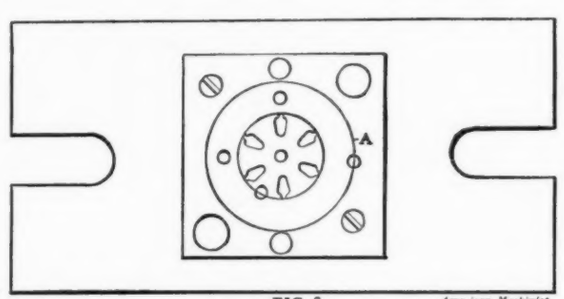


FIG. 3 American Machinist

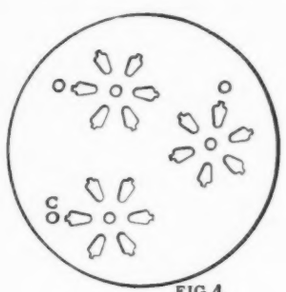


FIG. 4

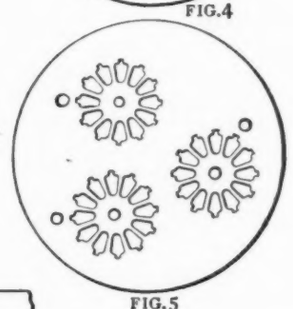


FIG. 5

PRESS TOOLS FOR SMALL ARMATURE DISKS.

and the hole *C* at the side, Fig. 4, for the locating pin *B* that is used in the second operation, where the six remaining notches are punched, which completes the disk with the exception of blanking, which is done with the usual simple round punch containing a pilot-pin. The center hole of the disk being placed over this pin, the blanking is done, which gives us a complete disk shown at Fig. 1.

Fig. 2 shows the construction of the punch holder and stripper plate *D*. Rubber is used to return the stripper plate to its position on the upward stroke of the press. It also sheds the iron from the punches. I prefer rubber to springs which acts as a die and makes the hole shown in Fig. 4 outside of each group of slots. The other hole is for receiving the pin used in the second operation and shown at *B*, Fig. 3.

The first operation on the disks is shown in Fig. 4, which represents a disk of sheet iron, this being a scrap piece left from punching disks for a 5 horse-power motor. As I had several barrels of these disks, they furnished a great many of the smaller ones, each one making three as indicated in Fig. 5. The first operation consists as in Fig. 4, of punching the six notches, the center hole that fits the shaft and use it on all dies for the notching of sheet iron. Fig. 3 shows the two pins in the die ready for locating the disks for the second operation. In this operation the round punches *E* and *F* are removed. In setting the die in the press, it is subpressed by two guide pins, and afterward these guide pins are removed; for, as the different pieces of scrap iron from which the disks are made vary in shape and size, some making ten to twelve of the small disks, the guide pins would be in the way. To be safe in its working, the shank of the punch holder is machined square, as indicated by the dotted lines

in Fig. 2, and fits the ram and clamp very nicely. I also use a thin sheet of soft paper under the die plate. This, I believe, helps a great deal to prevent any creeping of the die.

Up to the present time, this die has punched about 48,000 of these disks and has required to be sharpened in doing this seven times. Some of the iron has a hard, scaly surface and under these conditions I consider the die very successful. The disk is but 1 15-64 inches diameter, and is, I believe, the smallest that has been illustrated in your paper for some time.

Jos. H. Blair.

Cutting a Cavity at the Bottom of a Hole.

The accompanying sketches show a tool for cutting an enlarged tapering cavity at the bottom of a hole.

Fig. 1 is a sectional view on line *M M* of Fig. 2. *a* is a wedge placed in the bottom of the slot to give a taper action to the cutter; it is held in position by a dowel pin, shown at *f*, Fig. 2. *b* is a Mushet cutter, knuckled to piece of soft steel *c*, which has a projection *e* against which a tool or other piece of similar size, securely fastened in tool post, is placed, and when the feed is put on the carriage it forces the tool *b* to mount the wedge.

Fig. 2 is an elevation at right angles to Fig. 1, and shows the groove in which the tool works. Fig. 3 is a longitudinal section of a rope socket with the bar in position. Of course it will be understood that the rope socket runs in the steady rest during the operations of drilling and boring taper, the rest being usually at point *g*. The first operation is to drill the hole, which is usually 2⅜ inches diameter by 15 inches deep. Then the bar is placed in the hole, a wrench *C* put on the squared end and the tailstock brought up with center at *T* and pressure enough put on to hold the bar securely against the bottom of the hole during the cut.

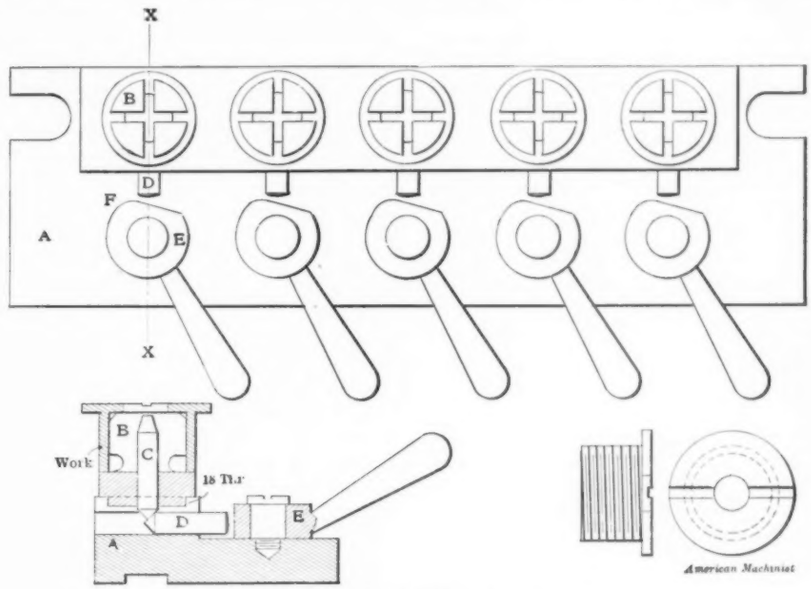
Wrench *C* rides on the carriage while the cutting tool is forced ahead by a tool *B* in the tool post, which presses against projection *e*. In Fig. 3 the cutter is shown at the extreme depth or at completion of the operation.

The dotted lines *A A* show where a hole will be milled through the side, which I will explain later, together with tools for the operation. We might state further that a greater or less taper may be obtained by simply substituting different size wedges at *a*.

Bill Greaser.

Slotting Fixture for the Hand Miller.

In the enclosed drawing the sketch at the lower right-hand corner is part of a patented automobile grease cup, requiring a shallow groove to be milled across its top face. To do this I designed and made the milling fixture shown. The body *A* of the fixture is of mild steel finished on all sides and with a groove milled in the bottom into which small blocks are placed to fit the slot of the milling-machine table. Into this body five small spring chucks *B* are screwed. They are opened and closed by the simple arrangement of the two small cone pointed pins *C* and *D* (shown in the cross-section) and the small cam lever *E*. The parts to be milled are all turned on a turret lathe.



SLOTTING FIXTURE FOR THE HAND MILLER.

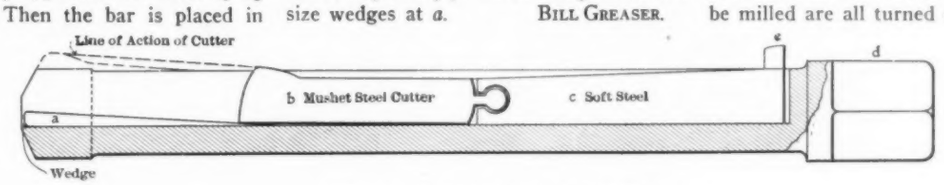


FIG. 1 Longitudinal Section on Line M-M

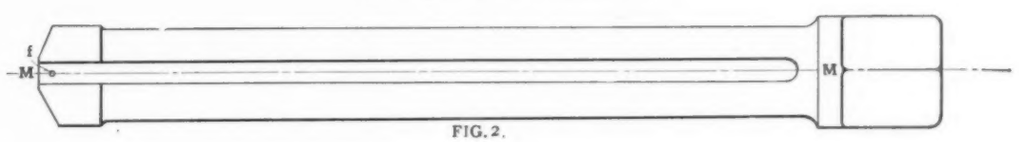


FIG. 2.

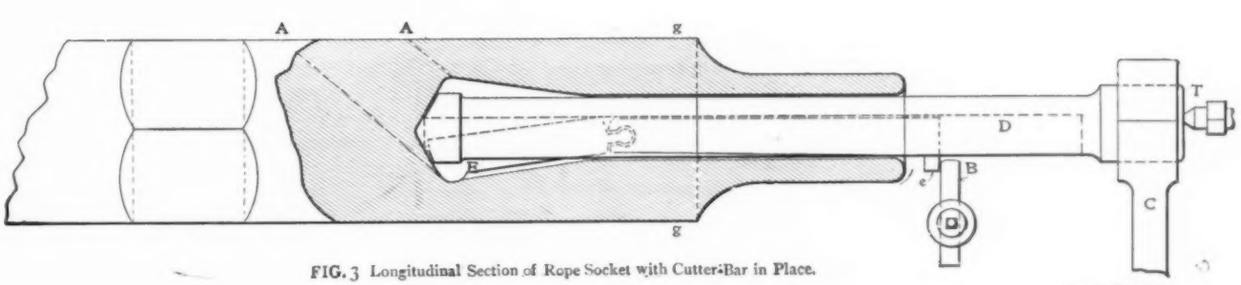


FIG. 3 Longitudinal Section of Rope Socket with Cutter-Bar in Place.

CUTTING A CAVITY AT THE BOTTOM OF A HOLE.

In the milling operation the boy places a part over the chuck *B*, then pulls lever *E*, thus forcing *C* upward and causing the chuck to hold the work firmly. It takes very little to hold the work, as the holes are all reamed to size and the chucks are only about 3-1000 inch smaller. After five parts have been chucked the work is fed past the cutter and then by a sort of sliding motion of the hand against the ends of lever *E* the chucks are instantly released, allowing the work to be easily removed. The parts are milled on a small hand-feed machine at the rate of 325 per hour. I. W. SPRINK.

Making Diamond-Shaped Washers.

The sketches herewith show how we at one time blanked out diamond-shaped washers; also the way we are cutting them at the present time.

Our former method was to blank and pierce them from the stock, as shown in

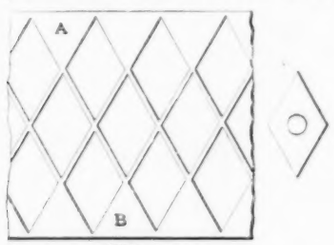


FIG. 1

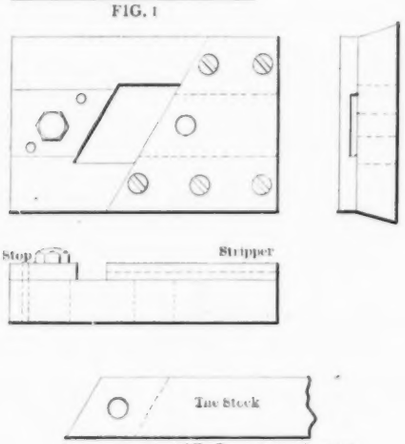


FIG. 2 *American Machinist*

MAKING DIAMOND-SHAPED WASHERS.

Fig. 1. While this method gave us satisfactory results, there was nevertheless a large waste of stock, particularly at *A* and *B*, which waste we have since profitably overcome without added expense, in so far as the operation itself is concerned.

By referring to Fig. 2 it can be very readily seen how this was done. Instead of the ordinary blanking and piercing die, a shearing die is used, the blanks being sheared from the stock without any waste of metal, with the exception, of course, of the 9-32-inch round punching.

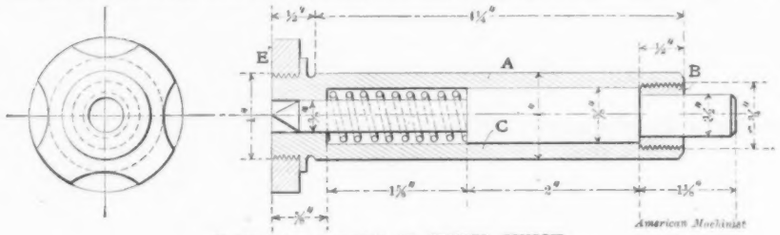
The die and the operation connected with it need no explanation, as the sketches show all that is necessary.

The punch (not shown) is made in the usual way, and is fastened to a dovetail back by which it is held in the press. The latter is a small bench power-press having a very short stroke, and is run continuously, thereby enabling the blanks to be cut with surprising rapidity.

E. F. EMERSON.

Punch for Locating Centers.

The accompanying drawing shows a center-punch made to strike centers through holes in sheet metal templets, or in circles scribed from such holes; it may



PLAN AND SECTION OF CENTER PUNCH.

be used also where it is desired to duplicate a job, as, for instance, in transferring holes from one finished boiler head to another, when it is possible to bring the heads face to face for this purpose.

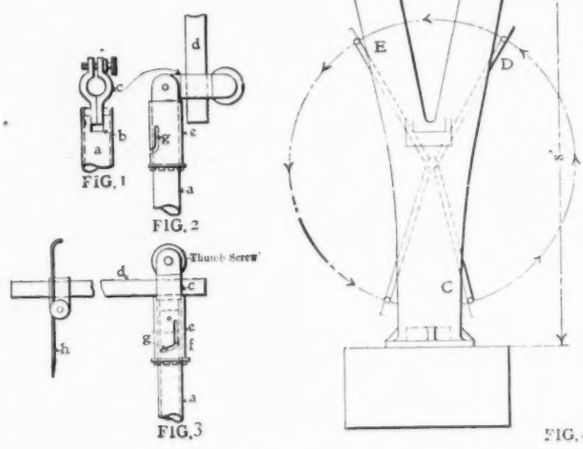
The tool consists of the nurled body *A*, drilled, reamed and tapped as shown; bushing *B* being threaded to fit the tapped end somewhat snugly, to prevent its working out, and punch *C* is made an easy fit through *A* and *B*. The steel spring holds the punch back in the position shown, with the point a little back from the bottom of the body *A*. The part *A* may also be made with a flange *E* solid when it is to be used only on one size circle or hole, but it is best made with the lower end of the body threaded to receive various sizes of flanges to accommodate the work in hand.

The necessity which called this tool into existence was the use of a thin templet which had holes full size, and it was not permissible, for various reasons, to clamp this templet to the work and use a bushing to drill through or otherwise strike the center, except by the laborious method of scribing the circle through the holes, afterward finding the center from these with the dividers. Now with this tool the transfer of centers is accurate within reasonable limits, and rapid, and there is the advantage of being able to use the templet with full-size holes.

When it is desired to use a tool like this to strike the center from a circle already scribed, one will find it to his advantage to notch the periphery of the flange *E*, so that the circle can be seen much better. W. M. FOX.

A Tram for Setting Large Work.

Under the above head at page 738, Vol. 28, Part 1, Cameron describes a tool which reminds me of one I designed to set large work on a horizontal boring and milling machine. At Fig. 3 *a* is a ¾ inch tube of any convenient length (36 inches in the present case), one end fitted to the hole in the short boring bar, the other end is slotted at *b* to receive the clamp *c*—an



A TRAM FOR SETTING LARGE WORK.

easy fit to allow it to swing. This clamps the bar *d* taken from a surface gage. *e* is a short sleeve fitted over *a* with the cam slot *f* engaging the pin *g*. Fig. 3 shows the sleeve *e* raised and partly turned clamping *d* at right angles to *a*. Fig. 2 shows it dropped back, allowing *d* to be swung parallel to *a*. Fig. 1 is a detail of the clamp *c*. Fig. 4 shows two views of an engine housing to be set by the line *A A* to mill the faces *B* and B^1. The needle *h* is set at *C*, the machine

spindle turned until D is reached, a distance of about 5 feet, thus setting vertically; the sleeve e is then dropped back and the bar d swung back to clear the job until E is reached when e is raised again, clamping the bar and needle in their original positions, setting the work parallel to the machine. If a tube can be obtained to replace the bar d it is less likely to sag when in the upper position. Though I am using a 3/8-inch bar 18 inches long, I get much better results than when setting from a line on the table with a 24-inch square and straight edge. Using an indicating needle to set to finished surfaces, very accurate results can be obtained.

A. S. MACKENZIE.

Making the Teeth for Spur-Gear Patterns.

At page 36 of Vol. 21 (1898) of the AMERICAN MACHINIST there is described a good scheme for making the teeth of wooden spur-gear patterns. In connection with this method, which is clearly described in the article referred to, I have seen an additional wrinkle for finishing

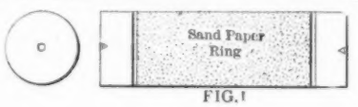


FIG. 1

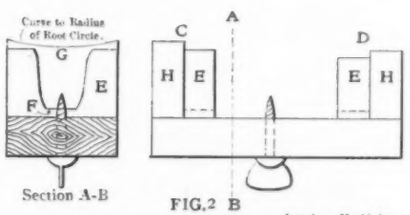


FIG. 2

MAKING THE TEETH FOR SPUR-GEAR PATTERNS.

the surfaces at the roots of the teeth where they are attached to the rim of the gear-wheel pattern.

Fig. 1 shows the hardwood roller having a piece of sandpaper wrapped around its central portion, the outer surface of the sandpaper being flush with the smooth cylindrical surfaces near the ends of the roll, all as described in the preceding article. After the outer end and working surfaces of the tooth have been finished by sandpapering, the tooth is put into the jig shown in Fig. 2, which is made of hardwood, and so proportioned that the distance $C\,D$ is equal to the face of the gear pattern, and the pieces E have the exact shape of the tooth cut in them, so that the distance from F to the arc G is the exact height of the tooth. The tooth is drawn down to a solid seat in the pieces E by the screw, and the bottom of the tooth is finished on the sandpaper roller as before, the pieces H acting as guides against the ends of the roller.

The teeth are now ready to be fastened to the gear, and if spaced with reasonable care a pattern will be obtained with all the teeth absolutely alike. This method has given us the very best of results.

Unfortunately I have no such accurate method for making worm-gear teeth. I know what I will try some day, but I have no results to report. Perhaps someone else may be able to give us some light.

"MASON."

A Stopped-off Mold for a Rectangular Column.

The most successful way and, therefore, the way foundrymen prefer to stop off rectangular columns is as follows:

Fig. 1 is a section of pattern for a rectangular column. Note center line A, which parts pattern and allows it to be

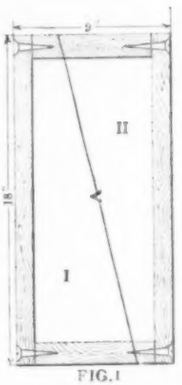


FIG. 1

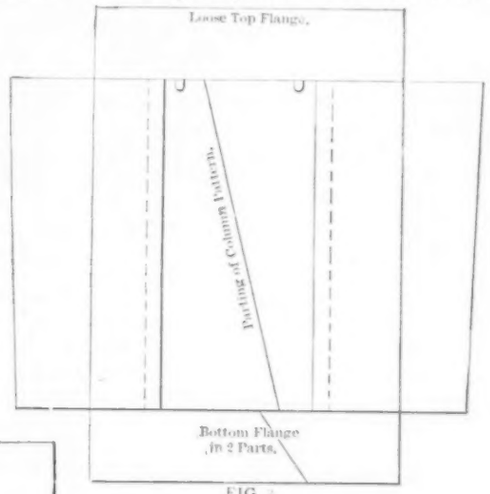


FIG. 3

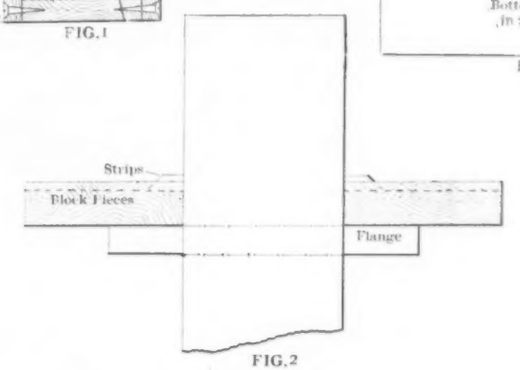


FIG. 2

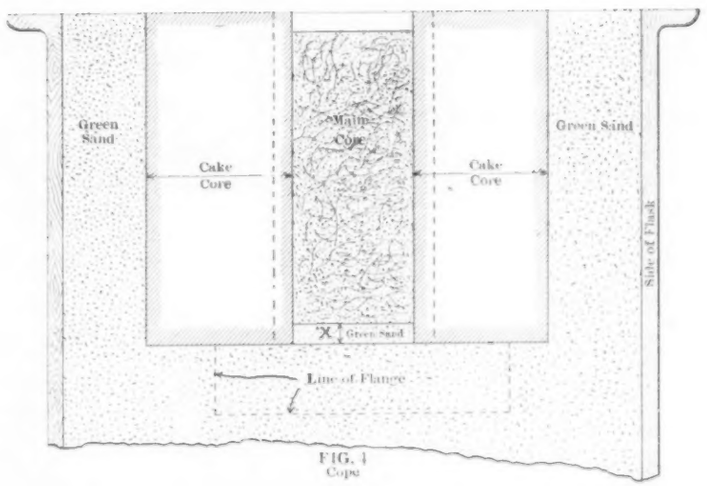


FIG. 4
Cope

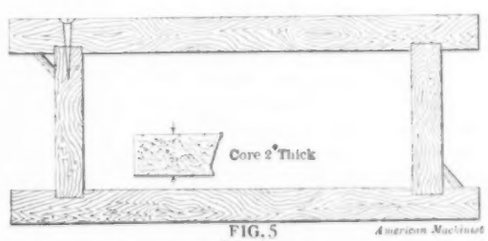


FIG. 5
Cake Core

FIG. 6
Stopping-off Piece.

A STOPPED-OFF MOLD FOR A RECTANGULAR COLUMN.

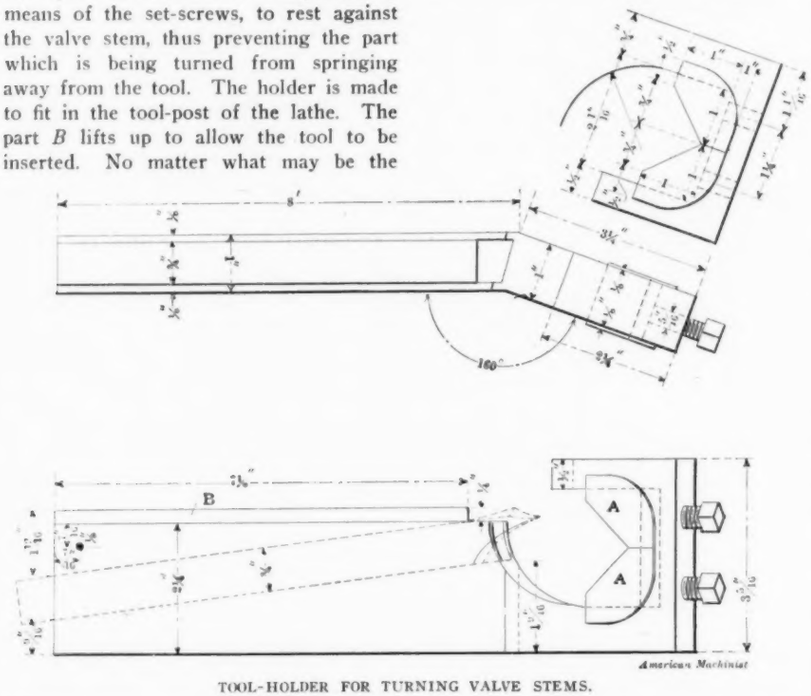
made perfectly square, as Part I can be drawn out first. Fig. 2 shows a plan of the column with core prints, blocks and flanges; these are loose on the body part of pattern, being held in place by strips, as shown. Fig. 3 is an end view of the column at the flanges. It will be noted that the bottom flange is made in two parts; it is held in place the same way as the block pieces by means of a strip. Fig. 4 is a section of flask when pattern is drawn and all cores are set in place. Fig. 5 is the core-box for the cake core used to place in mold when block pieces are removed; these are put against the main core, which stops off the column on both sides. Fig. 6 is the stopping-off piece for the top and bottom of column, making a seat for the main core to rest on.

Note that the column is molded on its small side, for if it were placed on the long flat side the main core would rise when metal is run and make the top side thin. The main core should be made on the long side. JOHN F. PITZ.

New York.

Tool-Holder for Turning Valve Stems.

The drawing here shown illustrates an ingenious tool-holder which is being used with marked success in turning valve stems. The main feature is the backrest, with jaws *A* which can be adjusted, by means of the set-screws, to rest against the valve stem, thus preventing the part which is being turned from springing away from the tool. The holder is made to fit in the tool-post of the lathe. The part *B* lifts up to allow the tool to be inserted. No matter what may be the position of the holder in the tool-post, the set-screw pressing down on the top of *B* holds the tool securely.



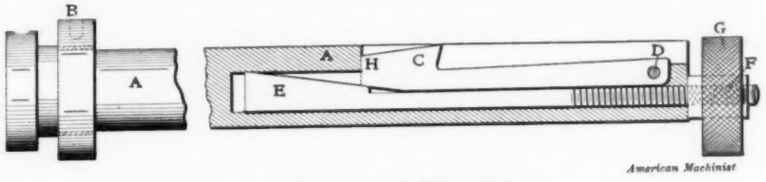
TOOL-HOLDER FOR TURNING VALVE STEMS.

While it was originally designed for use in turning up valve stems, the holder may be used for any lathe work which is of such a length and diameter that it will tend to spring away from the tool.

G. E. B.

Keyseating Tool for the Shaper—Milling Worms.

The sketch shows in section a keyseating tool I designed and made for use in the shaper. The job I made it for was keyseating some steel worms 6 inches long, 2 inches diameter, 1-inch hole, but it was such a success that it was subsequently used on other work of this description.



KEYSEATING TOOL FOR THE SHAPER.

Referring to the sketch, the holder *A*, of machine steel, was fitted to the clapper block, which of course was clamped fast, and held by means of the nut *B*. The straight part was made an easy fit to the holes in the worms, and left about 10 inches long. The cutting tool *C* was fitted in a deep groove cut in the holder, and butted up to the shoulder at *H*, which took the thrust of the cut. The pin *D*, on which this tool swung, was made an easy fit so that *C* might be raised at the head by the wedge *E* without jamming at *H*. *E* is a tool-steel wedge, turned down to ¼ inch diameter on the straight part and threaded for about 2½ inches up. *G* is a removable nurled sleeve, held by means of a headless set-screw (not shown) and used to turn the nut *F*. To operate, the tool *G* was taken off after sinking *C* below surface. The worm was then slid on and held by means of the shaper vise. The shaper was then started, after replacing *G*, and the latter was turned at the beginning of each stroke, till the full depth of cut was obtained. By means of this tool, using soap as a lubricant, I got a very nicely finished keyway, and the time taken was very satisfactory. I afterward used it for cutting the same size keyway, *i. e.*, ¼-inch, in larger holes, using an eccentric bushing.

The worms themselves, which were four to the inch, were cut in the miller, using the following rig: A "full swing" rest belonging to an 18-inch Reed lathe was bolted to the miller table, after fitting up with a pair of substantial bearings to take an arbor. The latter had an 80-tooth gear keyed to one end, meshing with a 40-tooth pinion keyed to the slide-rest screw. The latter being eight to the inch and right-hand, this brought the pitch right and reversed the lead. I also fitted a worm, which I made easily detachable, to the larger gear, in order to turn it more easily when the cut was on. I found no difficulty in cutting the worms in one cut with this rig, using the proper shaped cutter, and on afterward testing them in the lathe found them true to pitch and in every way satisfactory, while the time taken was only a fraction of that consumed in cutting them in the lathe in the usual manner. JOHN P. WHEELER.

Improved Crankshaft Lathe.

I notice at page 399 a description of a crankshaft lathe under the title, "Improved Crankshaft Lathe," and signed W. de Sanno.

That your readers may not be misled, I wish to state that all the essential points of this machine are covered by patents granted to me, and which have since been assigned to the Tindel-Morris Company, of Eddystone, Pa., and are now their property. There is no feature in the description of the lathe by Mr. de Sanno that has not been fully covered by my patents.

That my statements may be confirmed by anyone interested, an examination of the patents granted me will confirm the above statement.

The numbers and dates of the patents are as follows: No. 643,172, February 17, 1900; No. 649,374, May 8, 1900; No. 660,978, October 30, 1900; No. 666,040, January 15, 1901.

The lathes manufactured under my patents are known as the "Tindel-Albrecht" crankshaft lathes, and a detailed description of them was published at page 48, Vol. 27. ADAM TINDEL.

A High-Speed Milling Attachment—An Improved Thread Chaser.

The accompanying sketches show two shop fixtures which may be of interest to your readers. Fig. 1 shows a high-speed milling attachment for doing small end-mill work. Most milling-machine manufacturers supply an attachment for the above purpose, the spindle of which has its bearing within a bushing fitted into the taper of the milling-machine spindle, but the method shown herewith is, I believe, preferable, because the member which forms a bearing for the high-speed spindle does not revolve. It is of course necessary to revolve the milling-machine spindle to obtain a power feed.

L is the column of the milling machine,

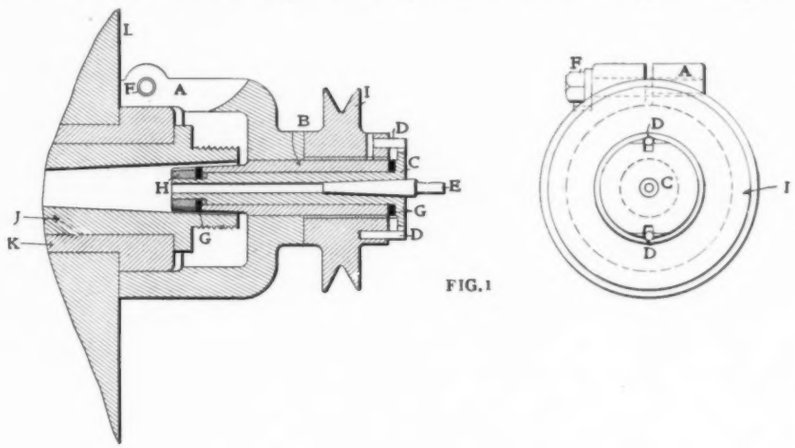


FIG. 1

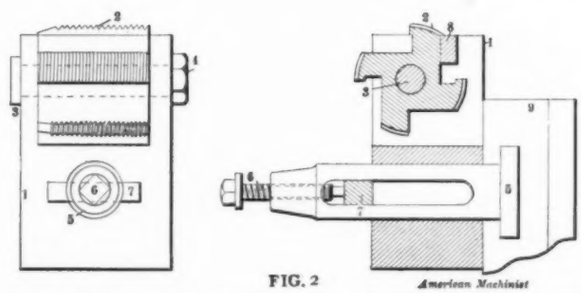


FIG. 2

American Machinist

A HIGH-SPEED MILLING ATTACHMENT—AN IMPROVED THREAD CHASER.

K the front bearing. Gray-iron support *A* is fitted over bearing *K* and is split and clamped to it by screw *F*. Support *A* is also bored to receive a hardened, ground and lapped tool-steel sleeve *B*, which is reduced below the size of the taper of milling-machine spindle *J* and extends within it to provide a sufficiently long bearing without an unusual overhang. The high-speed milling spindle *C* is of hardened tool steel, ground and lapped and fitted to sleeve *B*. Spindle *C* is tapered to fit and receive the mills *E*, and is flanged at outer end and provided with nut *H* at inner end for taking up end play. Fiber washers *G* serve to oppose thrust. The sheave pulley *I* is bronze bushed and is fitted loosely over the sleeve *B* and contains pins *D* projecting from its hub into the slots milled through the flange of spindle *C* to act as drivers.

It will be seen that the unevenness of the belt pull will not affect the spindle *C*, which has nothing touching it but drivers D. This device is intended to be driven by an electrical grinder, which is attached to the overhanging arm and supplied with a sheave pulley in place of the usual emery wheel. It makes another new use for that already versatile and handy little device.

Fig. 2 shows a chaser to be used in an ordinary engine lathe. It consists of a cylindrical tool-steel chaser 2, clamped within gray-iron holder 1 by stud 3 and nut 4. Holder 1 rests on top of tool-rest 9 and is bored large enough to fit over tool-post 5. A bar 7 is slipped through the tool-post slot and the screw 6 is tightened, clamping the device solidly. It will be noted that the chaser is made left-hand for cutting right-hand threads, and that it is milled out in four places, a "land" being left near the cutting edge for convenience in grinding when dull. A slot is milled across the holder 1 to receive a steel bar 8, which resists the downward thrust of the cut. This device was used for chasing some gray-iron disks about 8 inches diameter, 10 threads per inch and ¼-inch face. The disks were keywayed first and 8 of them were clamped upon a nut mandrel which carried a feather to drive the disks by their own seats. Two cuts were all that were necessary for a finished job, and as these were taken at about the usual chasing speed, it will be seen that a great deal of time was gained. Every experienced lathe hand knows how hard it is to keep a good point on a single chasing tool when working in gray iron, and personal experience with this device has convinced me of its utility.

ART ISAN.

Practical Appreciation.

Fancy poor old "Nemo" (who writes at page 154) wanting to be appreciated! And yet there are some employers who appreciate their men, and show it, too, in a practical form. Appreciation is, I think, a good investment for an employer—that is, when he bestows a little of it on his men.

When a manufacturer gets out a new machine, does it not gladden his heart to hear his customer voice his appreciation thereof? Ought he not, then, in common fairness to his employee, to voice his appreciation of a new part or machine designed by his draftsman, or a smart piece of work by his machinist?

As "Nemo" says, a word of praise goes a long way as an incentive; but how much farther will a raise of pay go in the same direction?

I was once with a firm who were very conservative in their business, and who insisted that the old-fashioned ways were ways of profit. No doubt at the annual balancing of books they showed a profit, and this being so, no amount of talking would obtain permission to do things differently.

Being young and ambitious to show my skill, I had many talks with the boss as to new ways of doing things, which I thought then (and have since proved) would result in a greater profit; not once did I succeed in getting permission to try them. At last I decided one day to start an improved method without the permit. The job had to be done surreptitiously (parliamentary fashion) in odd hours; by degrees it was finished, and proud I was to call in the boss to see it. The result was to the firm a saving of 75 per cent. in cost of production, and a saving of 10 per cent. of stock; to the operator, greater comfort and a slight increase of pay; to me it gained a reward of two shillings (about 50 cents). Only this and nothing more!

Yes, "Nemo," there are masters who appreciate what is done for them.

But I have heard of an employer who told his foreman machinist that when a man asked for a raise, either to give it him or discharge him then and there. Said he: "A man usually does not ask for a raise unless he thinks he is worth it. If he asks and doesn't get it he becomes discontented himself, and discontent is infectious; that is, his shopmates become discontented, too."

When a man asks for a raise and he gets it, he is more contented, and his output is increased; his mates seeing this, will endeavor to increase their output, and so

qualify themselves for an increase, too; so that appreciation is to the employer a good investment.

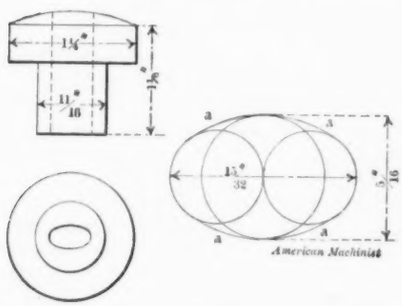
With regard to "Nemo's" boss keeping a draftsman and having to settle every little point himself, I think he is like a boss I once had. He used to point out things to his toolmaker which were obvious to everyone, and then on one occasion, when a tool contract was finished and his leading toolmaker ventured to ask for a raise on the strength of it, he was told: "Yes, it was a good job; but, you know, I had to tell you every blessed thing that was to be done and how to blessed well do it, too." CYCLO.

England.

Putting an Oval Hole Through a Steel Plug.

The sketch shows a "ledger" plate for a cigarette machine. These plates are made of tool steel, and the oval hole, which, of course, goes clear through, must not vary overmuch from a predetermined shape and size, and must also be true to the shank. The following is the method I adopted in making these pieces:

I first made a simple jig with two removable bushings, the first having two 15-64-inch holes touching each other, and the second having a 5-16-inch hole in the



THE WORK WITH OVAL HOLE.

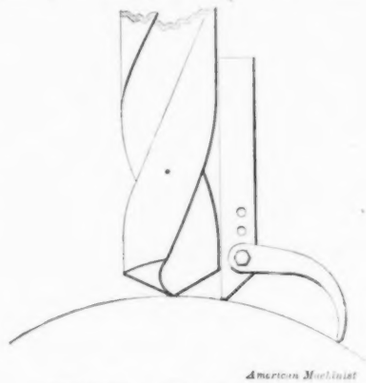
center. Having inserted the blank in the jig, the two 15-64-inch holes were drilled, and the bushing was then removed and replaced by the one with the 5-16-inch hole. The latter guided a 5-16-inch hollow mill, which removed the center part, leaving the hole as shown in the enlarged view. The small portions shown at *a a* were easily cut out by means of a broach driven clear through, which also sized the holes and insured unformity.

The blanks were then roughed out in the chuck, and finished to within .005-inch on an arbor milled rectangular on the miller centers, and with the corners turned off in the lathe, which was set slightly taper, till the arbor was a light driving fit in the oval hole. The pieces were then hardened and finished on the arbor by grinding. The variation of the holes in the hardening operation was not sufficient to do any harm.

JOHN P. WHEELER.

Tool for Squaring a Drill on a Shaft.

Some time ago I had a job of drilling some holes in a number of shafts for seating some keys. Of course I had to



SQUARING A DRILL ON A SHAFT.

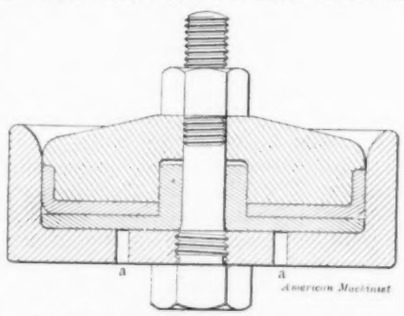
keep the holes looking toward the center of the shaft. To do this I secured an "old man," on the arm of which I scribed a line along the face which came in contact with the center of the air machine.

Taking a combination center-head and scale and placing the edge of the scale on the center line of the key-way and adjusting the arm of the old man until it lined up with the other end of the scale, brought my air machine, when set to the lines, in the correct position for drilling. After doing several shafts the thought struck me that I could save myself a lot of trouble by using a square. The square consists of a thin piece of steel—1-16 inch—jointed, as shown in the sketch, to a bent member, similar to the leg of an outside caliper. This can be handled and adjusted very readily; extra holes being provided for small shafts, and the joint being made in the lower hole for large shafts.

The corner is cut away for use on concave surfaces. J. G. P.

Mold for Cupping Pump Leathers.

It does not seem to me to be of any advantage to trim leather cups, as shown at page 700. I have had just as good results from cups that were untrimmed as from those with the most elaborate



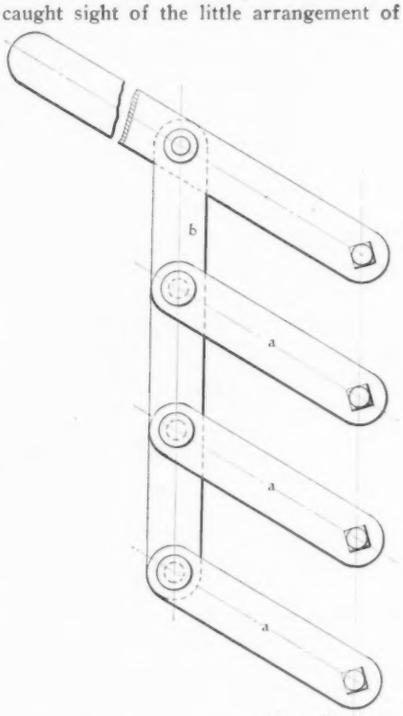
MOLD FOR CUPPING PUMP LEATHERS.

edges. I have used these cups for packing plungers as large as 12 inches in diameter with a pressure of 250 pounds to the square inch, and occasionally smaller cups under a pressure of 15,000 pounds per square inch, and never found any need to particularly trim, nor have the flange more than ¾ inch high. I incline to the opinion that the first fellow to make cups believed that the deeper they were the better, and the practice has never been questioned. It is easier to make saucers, takes less leather, and, for anything that I can see, they are just as good. I am not in this business just now, but beg to suggest to the craft to try a mold as shown in the blueprint herewith. If the cup sticks in the mold after the nut is taken off, as it does sometimes, drive it out with pins through the holes *a a*. The loose piece in the bottom is guided on the bolt, and protects the leather if it has to be punched out. The size to cut the blanks will be determined after a few trials. Worn-out cups indicate that the required depth is but little more than the thickness of the leather.

AMOS PRICE.

Device for Operating Gib-Screws in Miller Knee.

While through a shop on a visit I caught sight of the little arrangement of



DEVICE FOR OPERATING GIB-SCREWS.

levers shown in the accompanying sketch, and which was original with the milling-machine foreman. Its purpose is to tighten at once all of the gib-screws locking the milling-machine knee to the column, and it works like a charm. The short levers *a* were all made alike, as regards length, distance between holes and position of square holes with relation to the center line of lever. The holes in *b* are spaced to correspond with the spacing of the gib-screws. Before assembling, the gib-screws were all ground off at the ends when

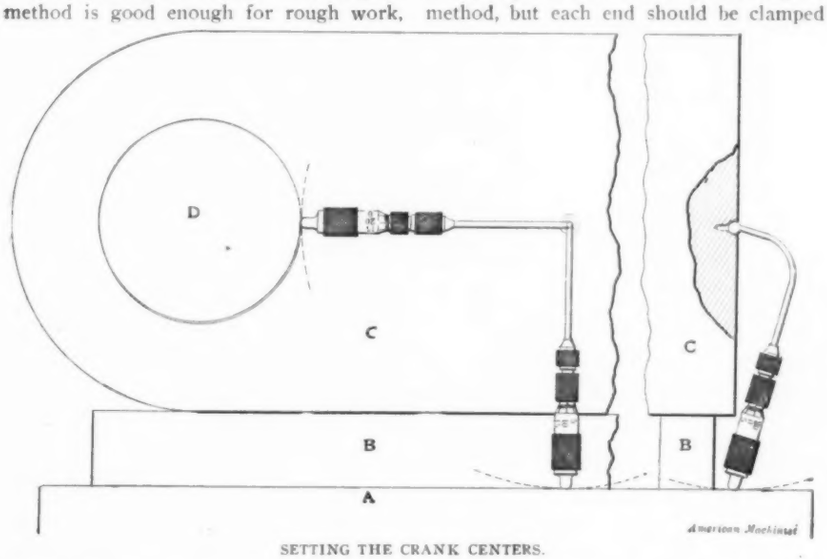
necessary, so that when tight each would allow its lever *a* to stand at about the angle shown, which is the tight position. The parts were then assembled. A movement downward from the position shown, and through an angle of about 60 degrees, is sufficient to loosen the knee.

W. M. F.

Setting Crank Centers.

W. A. Bright's article, page 297, Vol. 28, Part I, is good, but his criticism of my way of setting crank centers, at page 158, Vol. 28, Part I, shows he misunderstood the idea.

I think that he will have to use my method to find out if he has drilled the center accurately. The center can be laid off, as he says, and drilled to the circle, or as near as can be measured with the eye; but if he will take a pair of ball calipers and measure from the center to the table, he will find that his center is out of place from .003 to .010, and possibly more. To make the idea plainer, I will use a ball micrometer, as shown in the cut—*A* being the surface plate, *B* the parallel blocks, *C* the crank webs and *D* the shaft—so that he can measure in thousandths just how much the center is out of place. Measure from the shaft *D* to the pin center on each end to ascertain if the two ends are alike; then from the pin center to the table *A* to find out if these also are alike. This will determine whether the pin centers are perfectly in line with the shaft or not. Mr. Bright's method is good enough for rough work,



SETTING THE CRANK CENTERS.

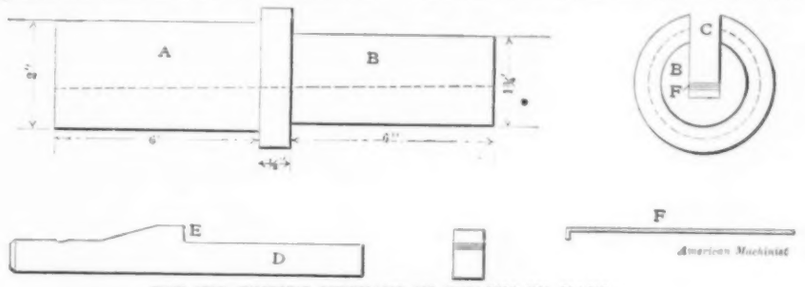
but where high-speed engines are required, or engines that must do heavy work and be economical, his idea is not practical.

A good way to make crank centers right is to bolt them together, bore the holes through both pieces—for the shaft ends only—and drive a plug through both securely, then bolt them on the face-plate of a lathe and drill and bore with a tool a hole at the pin center about ¾ inch diameter clear through both pieces; then drive a plug through the pin center, letting both plugs stick out at each end to rest on parallel blocks to plane the edges true with the holes. Then turn up two tool-steel plugs, tempered on center ends, and press one in each pin center hole. In turning these plugs it is not a good idea to take a piece long enough for both plugs and center each end and turn them up and cut them in two in the middle, because a live center in all lathes is out of true more or less, even when ground, and this will throw the center out of true with the outside. The best way is to turn these plugs separately and turn them on the dead-center end of the lathe and then cut them off. A hardened center should be used, because in roughing out a pin, the strain is all on one side, making the center wear oblong. It will not wear much in turning one shaft, but in turning a dozen it will be out more or less. When both end pieces are ready to put on the shaft, they can then be set by Mr. Bright's method, but each end should be clamped down on the faceplate, so when the setscrews are tightened up to hold them securely, one corner will not lift up and throw it out again. When the clamps are removed they should be tried with a ball micrometer or thickness gage. A ball micrometer can be made in a few minutes by bending a piece of wire that will fit an ordinary micrometer gage, using the balls from ball calipers.

MORTIMER PARKER.

Cutting Keyways in Pulley Hubs by Hand.

The accompanying sketches show an appliance for cutting keyways by hand in pulley hubs, etc., which I used with great success when a millwright at a factory which did not possess a slotting machine. The body is turned out of a piece of steel bar, with a collar left in the center, The ends *A* and *B* are turned different sizes to suit pulleys of different bore. A deep slot *C* is milled or shaped through, with the requisite amount of taper. *D* is a bar of tool steel shaped as shown, with a cutting edge at *E*. This cutter bar is made a nice sliding fit in the slot *C*.



TOOL FOR CUTTING KEYWAYS IN PULLEYS BY HAND.

To use the appliance, insert the end *A* or *B* in the hub of the pulley, then put the cutter bar *D* in the slot, put a drift on the chamfered end of the cutter bar and drive down; then pack back of the cutter bar with strips of steel *F*, and each time the cutter bar is driven down insert another strip, until the keyway is cut to proper depth. By this method keyways can be cut perfectly straight in a very short time.

W. D.

Y——, England.

A Kink in Piping Water-Cooled Guides.

In most marine engines, nowadays, water-cooled guides are the rule, and an experience of mine with regard to them may be of service. In the ship in question the heated water was carried from the tops of the guides by pipes connected to a common receiving pipe, and thence to the bilges.

It was thus impossible to ascertain when a guide or pipe became choked and failed to carry away the water. We had a hot guide due to this cause. The remedy proposed by the Chief and carried out one day in port was as follows:

The vertical pipes from the tops of the guides were copper, ⅝ inch external diameter. These had 5 inches removed from them 5 feet from the engine-room platform. Three-sheet Muntz metal funnels were made, 6x6 inches, with a ⅝-inch hole at the bottom; these were lapped and riveted with three copper rivets. The funnel was placed on the lower piece of the piping, with 1¼ inches projecting into the funnel. The space thus formed was run in solid with solder and well sweated—sea

water rapidly corrodes this material, and we got as much in as possible. When complete the man on watch could see the flow of the water into the funnels from each guide, and if stopped remedy it. I found subsequently that the superintendent had similar alterations made in other ships under his charge. A. L. HAAS.

London.

A Blanking and Piercing Die.

Fig. 1 shows a blanking and piercing die for brass pawls made from 1-16-inch flat stock. The punch, stripper and gage plates are not shown, the punch not being difficult of construction, and the gage plates being similar to some illustrated recently. By referring to Fig. 2, showing a section of the stock after punching, it will be seen that the die is so laid out that the holes match in very closely together, leaving only a margin of 3-64 of an inch stock, as shown at *A* and *B*. The arrows numbered 1, 2, 3, 4, merely show how the blanks are cut from the stock at each successive stroke of the press, while the arrows shown at the edge of the strip show that the metal is run through in the usual way, from right to left.

Wide stock is used for economical reasons, as wide brass can be bought cheaper per pound than narrow brass. Another very important reason for using wide stock and running it through the second time is that a strip of metal 3-64 of an inch wide, and the full length of the stock,

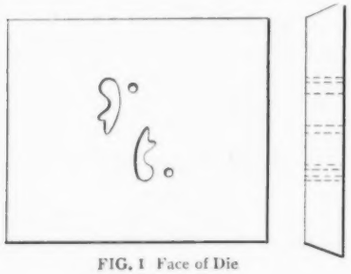


FIG. 1 Face of Die

The Pawl as blanked

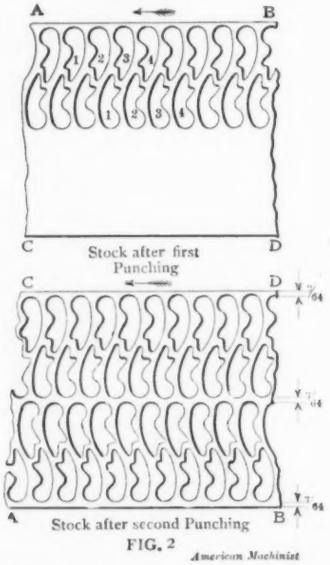


FIG. 2

A BLANKING AND PIERCING DIE.

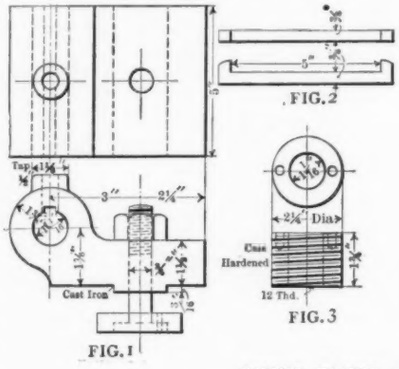
is thus saved on every strip that is run through—the waste on two narrow strips, wide enough for two rows of blanks each, being 3-16 inch, while for the wide strip with four rows it is 9-64 inch.

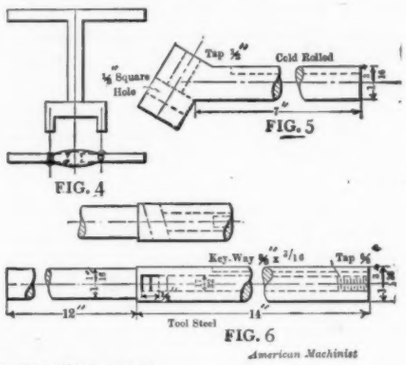
These blanks can also be cut from the stock by blanking four at a time, thereby eliminating the necessity of running the metal through the second time. This would, however, necessitate an expensive die, which the required amount of blanks in this case did not warrant making.

G. F. EMERSON.

Boring, Facing and Turning Tools for the Lathe.

The accompanying sketches show an outfit for boring, facing and turning, which has been in every-day use in our shop for nearly two years and has paid for itself many times over. The idea, as a whole, is, of course, not new.





BORING, FACING AND TURNING TOOLS.

We frequently have pulleys and flywheels to machine which are too large to swing over the carriage. With this rig all of the tools used for boring, facing and turning are held in the holder, can be changed much quicker than forged tools and cannot be set wrong.

Fig. 1 is the holder, which should first be machined on the bottom, secured in place on the rest, and bored exactly in line with the centers. The cross-slide should be gibbed tight while boring this hole. Fig. 2 is a key, which should fit snug enough to remain in place in the holder when the tools are being changed. Fig. 3 is a guide or bushing to be used with long boring bars. The center hole through the chuck was trued up and threaded 12 threads per inch, so that the bushing, when screwed up tight with the wrench in Fig. 4, would be about ¼ inch below the face of the chuck. Fig. 5 is for facing, and Fig. 6 shows the boring bar. A 17-32 inch hole is drilled lengthwise of the bar to the square hole, and the end is tapped about 2 inches deep for a ⅝-inch set-screw. The end of the bar is turned down to enter the guide bushing.

A piece of ½-inch drill rod of suitable length is beveled on one end to fit against the cutter; the other end is rounded to fit the cupped point of the set-screw. Both ends are hardened and drawn blue.

We have another boring bar 14 inches long, to be used without the guide bushing. It is like the one in Fig. 6 except that it is cut off where that bar is shouldered down to 1 1-16 inches.

For turning pulleys, etc., too large to swing over the carriage, a piece of 1 3-16 inch cold-rolled stock is keyseated like the boring bar. The square hole for the cutter is made straight through the bar instead of at an angle, and the cutting tool is held by a set-screw in the end.

HANDYMAN.

Loose-Leaf Books for Notes.

Keeping notes in a systematic manner is always an interesting subject. The card system is elastic and away ahead of bound note books, in which it is impossible to apportion the spaces in the way the notes will grow, but the trouble with the cards is they must be kept in a box, and unless locked in it an accidental fall means resorting the cards. The loose-leaf book has disadvantages, but it is more convenient than cards; the notes can be made with drawing ink, and the paper can be thin enough to permit of blueprint duplication.

I use the "S. & T. Loose Leaf Price Book, No. 614," for all sorts of engineering data, and have several covers, most of them of the one-inch thickness, and one-half this thickness for pocket use, in which is kept an assortment of the most constantly used material, the notes being constantly transferred to and from this book as needed.

For another purpose, I use an 8x5-inch

loose-leaf book, made by the John C. Moore Co., of Rochester, N. Y.; this concern makes a large variety of these books.

A. D. WILLIAMS, JR.

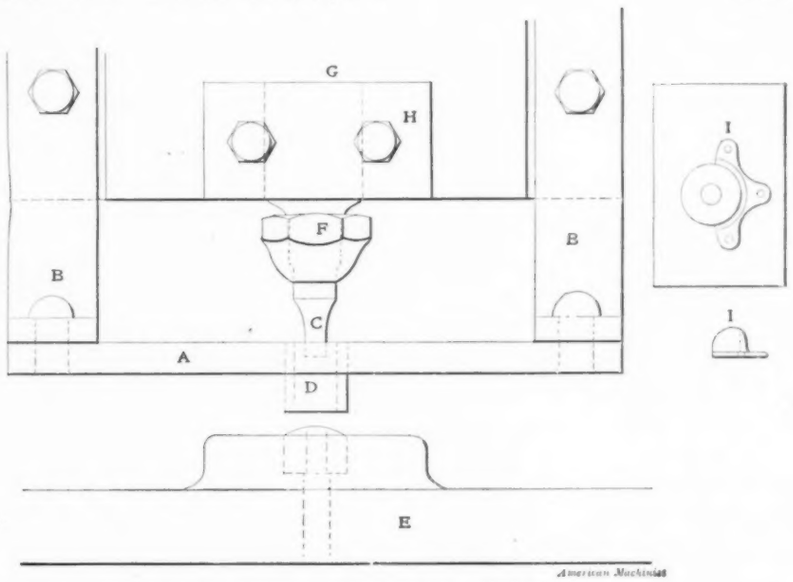
[We have used for the purpose mentioned above a No. 632 S. & T. Loose Leaf Book; size of page, 3¾x6⅞ inches. We have also found a very handy little book of similar species to carry in the pocket to be the S. & T. No. 212, which has a page 2x4 inches.—ED.]

A Punching Operation in a Stove Factory.

Some time ago I had occasion to visit a stove factory, where I saw them do their sheet-iron punching to templates. So when I was lately called upon to get tools out for similar work I made use of this system. Thinking that the method is new, at least to some, I will try to describe it.

A press is rigged, as shown in sketch: *A* is the stripper, about 2 inches wide and ½ inch thick, riveted to the two angle pieces *B*, which are held to the press with the guide bolts, this method of holding the stripper from the top leaving the space over the die clear all around.

Central with the punch *C* a hole is bored in the stripper so that the locating plug *D* can be driven in; this plug projects through the bottom of the stripper and is about two thicknesses of the sheet above the die. *E* is the die block, *F* a



A PUNCHING OPERATION IN A STOVE SHOP.

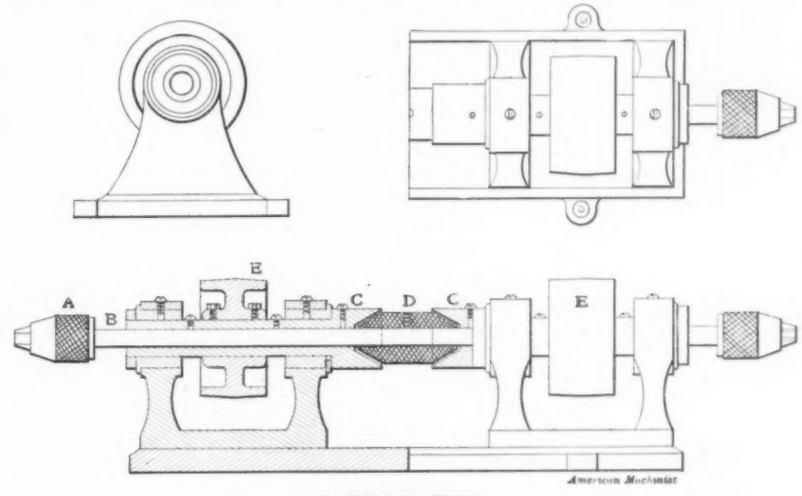
Pratt & Whitney punch holder and *G* and *H* are the ram and the punch-holder block.

Lay out a sheet just as wanted punched, drawing a circle around each hole, whose radius is the same as that of the locating bushing. Have some light castings made like *I*, also of the same radius as the locating plug, and rivet one of these to the outline of each hole, as shown in the drawing. Hold this templet by means of little clips to the sheet to be punched, and slip under stripper until the locating lug on the templet fits to the locating bushing in the stripper. By this means the hole will always be punched central to the locating lug, no matter which way you turn the work under the punch.

ALBERT D. KNAUEL.

Friction Tapping Machine.

The print shows a bench tapping machine constructed for work up to one-quarter inch. As will be noticed *A* is the tap chuck, *B* the spindle, *C C* the female



TAPPING MACHINE.

frictions, and *D* the male friction, the latter being of fiber and secured to the spindle. Driving pulleys *E E* are keyed to sleeve *C* and take open and crossed belts 1 inch in width.

In operation a slight pressure on the end of the tap with the piece to be tapped engages the turning-in friction; when the hole is tapped to sufficient depth a slight pull reverses the motion and the tap backs out.

The device is particularly useful for tapping holes where there is danger of striking bottom, the friction slipping and thus saving the tap.

For brass or composition a speed of 1,400 to 1,600 is recommended.

WM. SCHNEIDER.

Shall We Do Worthless Work to Order?

While this discussion of job shop ethics has run to a considerable length, there is one point which seems to me to be still untouched. To me the answer to this question would depend on whether I was running a simon-pure job shop or an engineering establishment. For I should say that any man who wishes to get a certain piece of machinery built or a certain job done and is willing to pay for it, failure or not, ought to be able to place his order, without regard to how foolish his requirements may appear to others.

On the other hand, if I were running an establishment which in any way or at any time depended for its patronage on the record of my engineering ability, I would be very careful, before the contract was signed, that the work offered could be brought to a termination satisfactory to a reasonable person. For such a place depends as much for its advertising on the jobs which it does as on any other means of getting before the public. If the advertisement is good, all right; but if it is bad there is no knowing how far it may be spread, for a dissatisfied man will continue to spread his opinions long after a pleased customer will have stopped talking. If his dissatisfaction is the result of his having attempted the impossible the failure may not really be our fault, but he may talk even louder than if it were our fault. It takes more than the average man to gracefully pay out money for a failure if there is even an imaginary loophole open.

It is especially desirable to look out for the building of machinery which must

be tested in the open, where anyone may see it. Every spectator to an unsuccessful test is a witness, and a willing one, to the inefficiency of the contracting firm even if he doesn't know whether what he saw was a flying machine or a potato digger.

A great many shop owners will say, "Why, of course, we don't run engineering shops," while as a matter of fact they do. There is undoubtedly quite as much mechanical engineering done in this part of the country without direct compensation as there is that is regularly paid for. If a customer comes to you with drawings all complete, and even asks your advice as to materials to be used, you are, if you give him your opinion, doing engineering work. If he tells you to use your judgment as to a change of a bolt, or a nut, or a spring, he is asking for engineering opinion. Whether it is wise to do such work or not is not the point under discussion, but the fact remains that it is done, and that hosts of shops depend for their patronage on the fact that they are able and willing to help their customers out of their difficulties. So most shops do more or less of an engineering business, the exceptions being mostly located in large cities. To sum up, I should say that it is right to do any job that is definitely offered, of course, provided it does not conflict with established law to do so, but that, if you care for the value which other people place upon your opinion, it is a matter of policy to be very careful not to do any work which will be apt to cast discredit upon you at any stage.

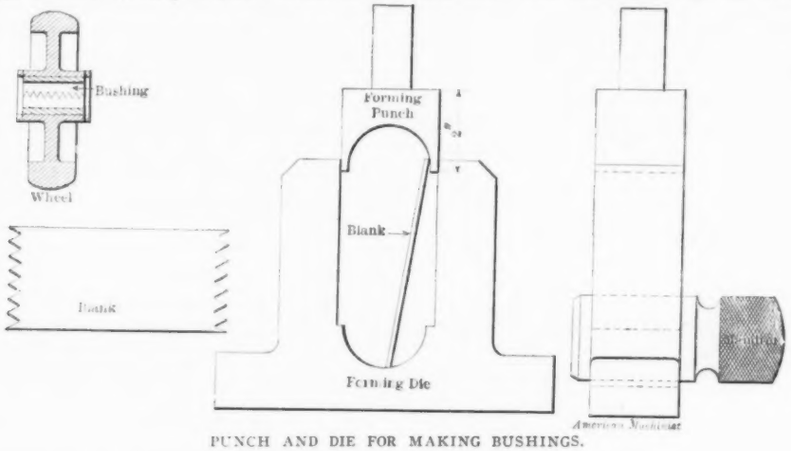
Another question of ethics on which I would like an opinion has come up lately. About three years ago I was engaged in the manufacture of a certain line of machinery. I invented a decided improvement on this line. As we were selling all that we could build of the old style I decided to hold up the new line, but showed my sketches to men whom I could trust. Later I changed my business and laid this invention on the shelf. A few days ago I was in a shop which is well known to all readers of the AMERICAN MACHINIST, and saw a machine built exactly according to my invention. Now, what I would like to know is this: Would I under the circumstances be justified in taking up the manufacture of this machine? There are no patents.

ENTROPY.

Making Bushings From Sheet Metal.

I took a contract to make 10,000 wheels as shown in the sketch. The wheels were made of gray iron with steel bushings hardened. The bushings were cut from steel tubing and, owing to the slight variations in inside diameter, caused much trouble. Thinking that the inside diameter did not vary from a standard size, I cut off a number and hardened them, but when it came to the assembling I learned the trouble, at a loss of about 2,000 pieces. If I put the bushings in after tempering I could not run a reamer through, and a soft bushing would not answer the purpose. I had all the finished wheels on hand and must provide some way to make a bushing that would answer. The wheels run on close fitting roller bearings; for this reason the inside must not vary over 3-3000. I made a blanking and forming die as shown, which answered the purpose very well, and the bushings so made gave no trouble in size or in hardening, and were produced at about one-third the cost of those made from seamless tubing. The teeth in the edge allowed for a slight variation in hardening and at the same time prevented the roller from falling in to the joint as would be the case with a straight butt joint.

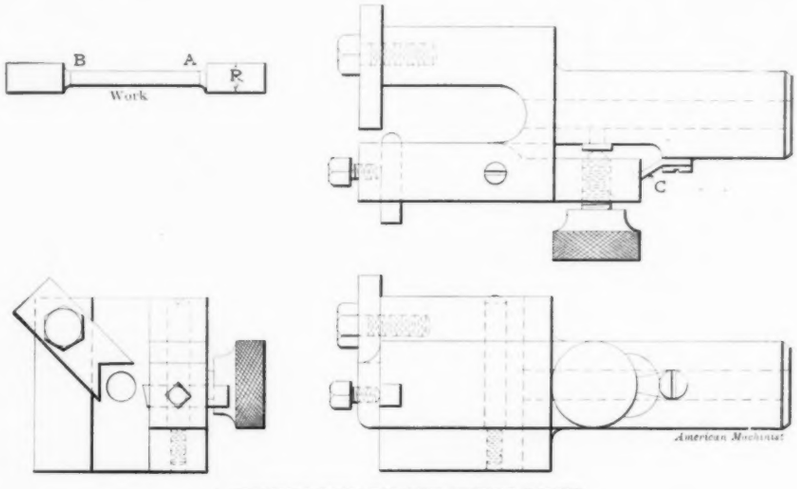
DETROIT.



PUNCH AND DIE FOR MAKING BUSHINGS.

A Turning Tool for the Turret Lathe.

I send herewith a sketch of a tool designed for the first operation in making a wheel-pin, or axle, for a bicycle, turning off the middle for lightening purposes. Usually, after cutting off, this job was done throughout on an ordinary lathe, and although this was considered to be too costly, the idea of it being done on a turret lathe was out of the question on account of the lack of a suitable tool. I may say here that this refers to an old cycle factory, where up-to-date modern machinery had not yet made its appearpearance, and the only turret lathe available was an old wire-feed—one of the first, judging by its appearance; in fact, it had been thrown aside as scrap. After weighing the matter up, it was decided to have the old machine renovated and give it a trial on this job. Well, we had the tool box made as shown in the sketch, and started in to make axles throughout on the turret lathe.



A TURNING TOOL FOR THE TURRET LATHE.

The chief feature of the tool box is that the steady is ahead of the tool. After setting the stop for the length of pin, the throw-out stop on the slide was set, so as to bring the tool up to *A;* then the feed-screw was operated, which gave the necessary cut. The stop was then thrown out and the tool fed up to *B*, the screw stop at the end of the slide having been set for this distance. The feed-screw was then operated the reverse way, the spring *C* taking the tool back from the work. Everything now being clear, the tool was withdrawn and the pin cut off, complet-

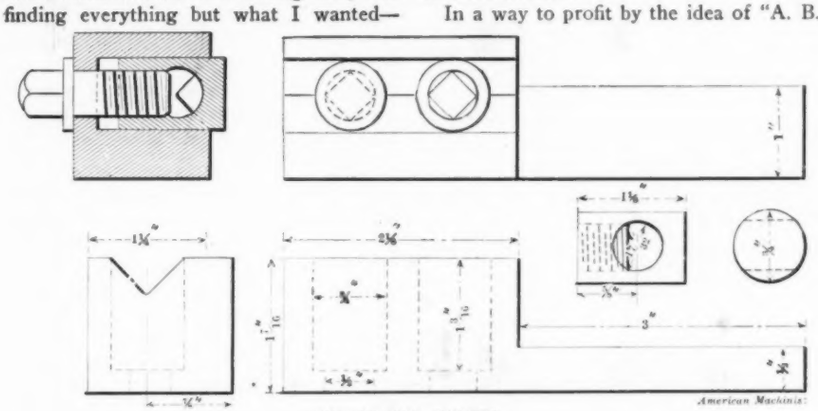
ing the first, and, under the circumstances, most difficult operation.

This method was a great way ahead of the old one, as regards both quality and quantity of work produced, and was therefore pronounced a success.

J. PRICE.

Boring-Tool Holder.

Having some trouble in looking for a small inside thread and boring tool, and finding everything but what I wanted—some too long and others too short—led me to devise the tool-holder represented by the sketch.



BORING-TOOL HOLDER.

The size of holder shown will receive boring tools from ½ inch in diameter down to ⅛ inch or less, and these can be shortened or lengthened according to the depth of the hole being bored. S. C.

The Inset Box-Section Cross-Rail—Bolt Heads and Nuts—Two Tools in a Planer Cut.

In your editorial at page 294 you refer to a "planer cross-rail as being a four-sided box between the housings." Why between the housings? Why not set the housings back and run the box cross-rail right through? We have two machines with the box running straight through, and they are about the only ones I ever saw good for anything. I know the man who would sacrifice good features for convenience will say that the tool in the side-heads will not be in line with the other tools. I know when the job is that of planing plates where the top and sides are the same length, this arrangement would delay the work a trifle, but then what proportion of all the work is of that nature? With a machine that has business in it, the gain in cut with a rigid cross-rail would more than make up for loss in time.

I once made a set of models, using the same kind and weight of material in each, and determined that the four-sided box was thirteen times more rigid against torsion and four times more rigid against bending than the ordinary side-plate, cross-girder sort.

The article from your contributor "A. B. C." supplements my article on the "Things That Are Usually Wrong," and one feature reminds me of an incident that occurred at Cornell.

We had made a special lathe in which all screws and nuts that were operative fitted and were operated by the tool-post wrench, the nuts being cap-nuts with a squared projection. Expatiating on the merits of this feature to a friend, he said: "What in the world would you do if you lost the wrench?"

In a way to profit by the idea of "A. B. C." to get along with fewer wrenches, we make all bolt-heads the size of the nut for a bolt one size smaller; that is, the head of a ¾-inch bolt is the size of a ⅝-nut, and that is large enough, for no one can draw such a head through a hole. In this case a ⅝-inch wrench will hold the bolt and the ¾-inch turn the nut; and, too, in the case of lock-nuts we tap out a nut one size smaller for the upper nut,

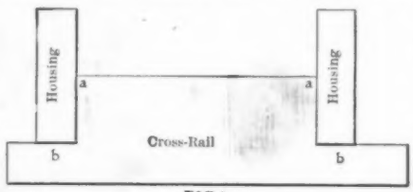


FIG. 1

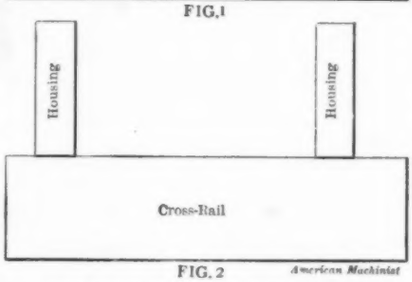


FIG. 2 American Machinist

THE INSET BOX-SECTION CROSS-RAIL.

which also makes a better looking job: and one set of wrenches meets all requirements, whereas in the usual plan two wrenches of the same size are often required.

One of our planer hands has revived a dodge that was used here and forgotten twenty-five years ago: He had occasion to take a ¾-inch roughing cut, and in coming out at the end had to chip off the corner to prevent breaking down too deep; so he put in two tools of the same size steel, which the tool box would hold easily, and set them so the first one would take about two-thirds or three-quarters of the cut and the other the balance. This not only saved the chipping, but enabled him to take a coarser feed, saving one hour in seven.

This, as indicated above, is an old trick; but the old planer hands die or forget, and the new men do not "catch on."

JOHN E. SWEET.

[Possibly Professor Sweet misunderstands the construction referred to, and others may. We append a sketch plan, Fig. 1, showing the arrangement. In this the cross-rail is not only clamped to the faces of the housings at *b b* in the usual manner, but is also clamped to the housings at the points *a a*. There is by this arrangement no increased overhang of the saddle and tool, while at the same time great depth of cross-rail is secured, with a fastening to the housings which seems to give the utmost rigidity. As we understand the alternative construction proposed by Professor Sweet, it would be as shown in Fig. 2; and it looks as though that shown in Fig. 1 is much superior.—Ed.]

Information Gratis.

As a rule, engineers are anything but a frivolous class of men; but occasionally one comes across a black sheep. Recently a solemn-looking individual strolled into the refrigerating engine-room and asked Mr. Guppy, the light-hearted second, to give him a little information about his engines.

"Why, certainly," said Guppy, "those two brass knobs over there are called the jeremididlers, and that thing like a distorted mangle is the freezer. Now the jeremididler—so called because of its resemblance to a boiled owl—is really generating electricity flavored with red currents—you understand? Well, when we stir up the conflicting elements with a brass poker and an old clay pipe, the jeremididler is connected with the freezer, and, owing to the ammonia extracted from the pipe mixing with the electricity, it freezes the freezer so cold that we have to find out the temperature with a six-foot thermometer, and——"

"My word," said his questioner, "that's wonderful!" and he walked off.

"Hear me kidding the old chap?" said Mr. Guppy, with a wink, to the chief, who had been standing by. "He's as green as a new cheese."

"Yes, I've often thought so," said the chief quietly, "but he's the inspecting engineer for the company, all the same."

The Hamburg-American Steamship Company's first turbine steamer, the "Kaiser," made a successful trial trip, September 26, reaching 20 sea miles an hour, or a mile above the contract stipulation.

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The Demand for Engineers.

At page 95, under the title "The Plight of Technical Graduates," we published some extracts from a letter from Berlin in which were set forth the deplorable conditions to which technical graduates have been reduced in Germany by reason of the oversupply of such graduates, and in the same article we gave some extracts from a recent editorial in *Engineering News*, wherein was given the opinion that much the same state of things exists in this country, at least so far as the field of civil engineering is concerned, our contemporary going so far as to say, "We risk little in saying that the average holder of a civil engineering degree spends half of his first three years looking for a job."

The opinions given in our article have been republished in English journals, notably *The Engineer*, the opinions being, however, credited to us instead of to their real source. The re-publication has been followed by a considerable correspondence in which much the same state of affairs has been claimed for England and, in some instances, decided opinions have been given that, in the face of these conditions, a halt should be called on the decided advance in the organization of colleges of engineering, which is now a well-marked movement in England.

It is not our belief that the descriptions fit the conditions as found in this country, at least in mechanical engineering. No one having much acquaintance among teachers of mechanical engineering can have failed to have heard their statements of the actual demand which exists among manufacturers for their graduates. Not long before his death the late Dr. Thurston told the writer that for years he had received more calls for his graduates than he had been able to fill, and similar expressions have been heard from other educators. No doubt the positions to which these graduates are called involve little responsibility and at correspondingly modest salaries, but that does not affect the question, which relates to the supposed difficulty which such graduates have in finding openings.

Moreover, we have some personal knowledge of cases in which manufacturers have made applications to engineering schools, for graduates to be put in the line of training to fill positions which they had found it difficult or impossible to fill otherwise. We know perfectly well, too, that in many cases the results have been disapointing, but this is a matter of the capabilities of the men supplied to meet the demand and not of the existence of the demand. It is certainly a fact, too, that among our own acquaintance with graduates in mechanical engineering we know of very few indeed of whom reasonable success might have been expected who have not been reasonably successful.

We need not, however, trust to general impressions in this matter. Some of our readers will remember, as all should remember, the Presidential Address of Mr. Jas. M. Dodge, read at the 1903 New York meeting of the American Society of Mechanical Engineers, on "The Money Value of Technical Training"—an address which dealt directly with this subject. Mr. Dodge had obtained particulars of the progress of many men of no school training and of various degrees of such training, and he plotted the average of these in a diagram to illustrate the varying rates of progress. His aim was, primarily, a comparison between the rates of progress of the different classes of men, but his results have an absolute as well as a relative value.

He found that, graduating at an average age of 22, the average rate of pay of graduates of schools of mechanical engineering was $13 per week, that at 25 this rate had increased to $22, and at 32, at which age his inquiry stopped, to $43 per week, or $2,236 per annum. This, of course, does not represent gilt-edged success, but Mr. Dodge was not dealing with gilt-edged men. As a measure of the progress of the average man, which it is, we think it represents a satisfactory condition of things, and it certainly represents a condition far removed from those given in the doleful stories from England and Germany.

In the nature of the case Mr. Dodge did not deal with those who, after graduating in engineering, did not attempt or who, attempting, failed to follow engineering permanently, and of this class there are no doubt a good many. This, however, does not affect the essential question as it has been discussed by our English contemporary and its correspondents. That discussion has endeavored to show the unsatisfactory condition of the engineer's vocation by pointing out the small pay received by engineers in middle life, and to this Mr. Dodge's figures relate directly.

Our Numerous Boiler Explosions.

While the "Bennington" disaster is still fresh in the public mind is a good time to remind our readers that it is but one of the far too numerous explosions of American boilers. It is a pity that the American people at large, and especially American engineers, cannot see some of the severe, albeit thoroughly justified, comments on these explosions which appear in European journals. The English *Mechanical Engineer*, for September 9, contains some comparisons between the number of such explosions in England and the United States, its figures for the former being from the returns of the Board of Trade, and for the latter from the well-known statistics of *The Locomotive*, published by the Hartford Steam Boiler Inspection and Insurance Company. *The Locomotive* reported for a single month 51 explosions,

resulting in the death of 25 persons and the injury of 47 others, while, according to the Board of Trade returns for the last 22 years, the average number of such explosions in Great Britain *per annum* is 69, resulting in 28 deaths and 60 cases of personal injury. In other words, roughly speaking, boiler explosions are about twelve times as numerous here as in Great Britain. How the number of boilers in the two countries compare, we do not know; but such knowledge is not needed to warrant the assertion that the comparison is altogether discreditable to us. It is quite in keeping with the equally discreditable number of railroad "accidents" which are constantly occurring on American roads, and, curiously enough, the ratio, expressed as the distance which the average man may travel before being killed on English and American railroads, is about the same—1 to 12.

It is easy to find all sorts of excuses for these facts—excuses which the maker looks upon as excusing them—but the fact remains that they are a national disgrace, and a disgrace which falls chiefly on American engineers. The only explanation of them lies in carelessness and incompetence, the blame for which engineers of high or low degree must shoulder.

Addresses Wanted.

It sometimes happens that, for one reason or another, men who are connected with the machine business wish to know the present addresses of others who are also now, or have been, connected with the business, and cannot find them. Friends often become separated, and not only do they wish to be placed in communication on that account, but sometimes for business reasons it is important. We have been of service in the way of bringing people together on several occasions, and are always glad to render such service. Any of our readers who may wish to know the address of others connected with the machine business, and who cannot otherwise find the address, may be put in the way of doing so by sending us a request to that effect.

Those who believe in trade with foreign nations and in the development of our foreign market will be pleased at what was said by the German Kaiser's counsellor, Herr Goldsberger, on the occasion of a dinner given to Consul-General Mason when leaving Berlin for his new post in Paris. Herr Goldsberger believes evidently that trade can be established between Germany and the United States which will be mutually advantageous, and in speaking to this point he is quoted as having advocated a reciprocity treaty in the sense in which President McKinley's last public address meant that such treaties should be formed, calling attention to the fact that equivalent advantages must be given. Herr Goldsberger urged fair play in executing and administrating whatever arrangement might be made, and hoped that the forthcoming negotiations would result well for the trade of both countries.

Engineers in the Navy.

The report of the Board of Inquiry into the "Bennington" disaster has been submitted to the Navy Department and has, in the main, been approved. The department has, however, gone further than its recommendations by ordering not only the court martial of Ensign Wade, who was in charge of the machinery of the "Bennington" at the time of the accident, but also that of Commander Young, who had charge of the ship itself. The latter officer has declared his expectation of being completely vindicated by virtue of the fact that he had, on numerous occasions, reported the boilers of the "Bennington" to be absolutely unsafe, and that, as his warnings were unheeded, responsibility for a tragedy which caused the Navy more than three times as many lives as were lost in action in the war with Spain rests primarily upon the department.

It seems to us that the only possible culpability of Commander Young might lie in the possibility that certain disagreeable rumors regarding the effect of San Diego rum upon the men immediately in charge of the boilers might have some foundation in fact, and have indicated a laxity in discipline, not, perhaps, without precedent in the Navy, but certainly without the possibility of justification. It is almost inconceivable, as one of our contemporaries remarks, that men in a sober condition, who were in possession of any knowledge whatever upon the subject of boilers, should have gone on firing under the boiler when the lack of pressure in the gage could not but have indicated that something was wrong. It is also very much of a mystery how the air cock, not being closed, failed to sound a warning.

Whatever the true explanation may be, it is quite certain that those immediately responsible, as well as those ultimately responsible for the condition of affairs which made possible the explosion, are entirely beyond the reach of any human court martial; and that we must look for an improvement in matters to an entire rehabilitation.

As we have repeatedly stated in discussing not only this particular disaster but other features in connection with engineering in the United States Navy, the present is above all things an age of specialists; and what the Navy needs for the work connected with engineering duty on its ships is, primarily, a corps of specialists, whose entire training has tended toward the one end of fitting them for the duties which, in the service to which they are accredited, they are called upon to perform. The requirements of that service are continually increasing, as is evidenced by the fact that the latest ships of any size in the Navy have machinery plants of from 16,000 to 25,000 horsepower and upward, as compared with the plants ten years ago, which exceeded in only a very few instances 10,000 horsepower. As a direct effect of this, any change in the personnel should be toward a decided increase in every respect, not only in numbers, but also, and in perhaps larger degree, in general efficiency as well.

It would be idle to look to the naval academy for this. The situation demands instant relief, and no man leaving the academy could be safely entrusted with such responsibilities as are now lying around loose and uncared for in less than five years from his date of graduation—sad experience has proved that—and those five years must needs be spent in earnest and diligent work, actually in an engine-room. It is safe to say that, were the entire equipment of the academy devoted to this sole purpose, at least ten years would elapse before we had an engineering force commensurate with our requirements—both quality and quantity considered. The only solution suggested, which appears to us to bear the hall-mark of sanity, is to open the door for the introduction of men from civil life. Not only this, but it will be found necessary to insure them treatment due a white man—not that usually accorded a yellow dog. Men possessing the requisite qualifications are men of standing and character. No other will do. This fact must be recognized. And such men will not enter the service unless they can be assured as considerate treatment as their training (in our great technical schools), their abilities, and their characters would provide them in their usual vocations ashore.

It is not at all necessary that the Navy should return to anything of the same general nature as the old engineer corps, which was abolished by the Personnel Law of 1899. We do not want a return to conditions in which the bitter feelings (on account of social matters and questions of rank and priority) between line officers on the one hand, and engineer officers of equal training, gentlemanliness, and capacity, on the other, furnished a beautiful target for cartoonists and professional humorists. The case is one where military titles, fuss and feathers, and gold lace, should not be allowed to dictate policy. The respect and dignity which the position of engineer on one of our large naval vesels should command can be attained only by granting to that officer privileges and authority commensurate with the responsibility which he is called upon to assume; and until the department and Congress look this matter squarely in the face and realize the truism of the above statement we cannot expect much relief. It is beyond all question that we *must* have a competent engineering force, and that in order to obtain it we

must sacrifice, if necessary, all pet prejudices entertained by junior officers of the line in favor of their intrinsic, indisputable and immense superiority over men whose duties require them to take care of machinery, in the proper operation of which they are liable to get their hands dirty. The general snobbishness responsible for the conditions which brought about the law of 1899 is, in many respects, attributable to the fact that officers of both the Army and the Navy have in many cases, particularly when they are quite young, come to look upon themselves as beings quite removed from ordinary personages, and to assume that the gold buttons which they wear entitle them to the universal obeisance of mankind.—*Marine Engineering.*

An American traveling abroad inquiring into trade conditions, with special reference to the promotion of American commerce, writes to the Bureau of Manufactures that certain foreign manufacturers in England and on the Continent imitate American products and sell them under the title "American made." Some "American" articles sold in Europe and elsewhere, he says, are really of European make, but made after American patterns, and the English and French, as well as the Germans and Austrians, are doing more or less of this, both for the home markets and for exportation. Apparently quite large quantities of genuine American manufactures are being sent from England to Egypt, India, the Straits Settlements, China and Japan. He is further quoted as saying that considerable quantities of merchandise originally made in the United States reach France from England, the Netherlands and Belgium, being imported, however, as products of those countries, thus securing in some cases the benefit of the minimum tariff rate which France does not accord to the United States. This, he says, may explain in part why our direct exports to France do not increase as rapidly as to England, the Netherlands and Belgium.—*Western Electrician.*

It is getting to be quite common practice to add a little phosphor-tin to composition or steam metal just before casting, in order to produce freedom from pin-holes and impart a free-running quality to the metal. This practice is to be commended and will give excellent results, particularly if much scrap is used. In steam metal, for instance, which has been made from good copper, tin, spelter and lead, the addition of phosphor-tin is hardly necessary and, if the melter has done his work carefully, no beneficial results can be noticed. As few melters do their work carefully, however, the addition of the phosphor-tin is usually conducive to good results.—*Brass World.*

New Tools and Machine Shop Appliances.

ROTARY SURFACER.

The half-tones illustrate a new grinder known as a rotary surfacer, and constructed especially for grinding slide valves and piston rings, fitting heads on cylinders or for any round work where air, steam or water-tight joints are required. The table, which is 32 inches diameter, has a stem 14 inches long, tapering from 4 inches diameter, and running in a phosphor-bronze bearing, which is provided with means for compensating for wear. The drive is by worm and worm-wheel which run in an oil bath and give the table a smooth motion; and a magnetic chuck may be provided for the work when required. The driving pulley and shaft will be noticed in Fig. 1. The four-step cone takes a 2½-inch belt, and the step diameters range from 5⅛ to 10 inches. The emery wheel, which is 10 inches diameter and of any width up to 2 inches, feeds automatically across the work and has a power-elevating device which is shown at the top of the upright. The feed-screw and other mechanism for reciprocating the upright and wheel will be seen in Figs. 2 and 3. The wheel spindle is 2¼ inches diameter at the portion receiving the wheel, and the main bearings are 10 inches long, the front box tapering from 2½ to 4 inches diameter, and the rear box, which is straight, being 2½ inches diameter. The flanged pulley on the spindle is 6 inches diameter by 7 inches face. A 4-inch overhanging arm supports the other end of the wheel shaft, which is reduced to form a bearing 1⅞ inches diameter by 3 11-16 inches long. The feed-screw is 1½ inches diameter, is cut four threads per inch and geared 3 to 1, the clutch pulleys which operate it being 6 inches diameter by 2 inches face.

The principal bearings are all well protected from dust, and water is supplied

FIG. 2. ROTARY SURFACE GRINDER.

to the work from a reservoir formed in the base by a centrifugal pump. The upright of this machine is 20x30 inches, and the wheel saddle 14⅞x32½ inches. The height to top of table is 32 inches, and the total height 67 inches. The wheel

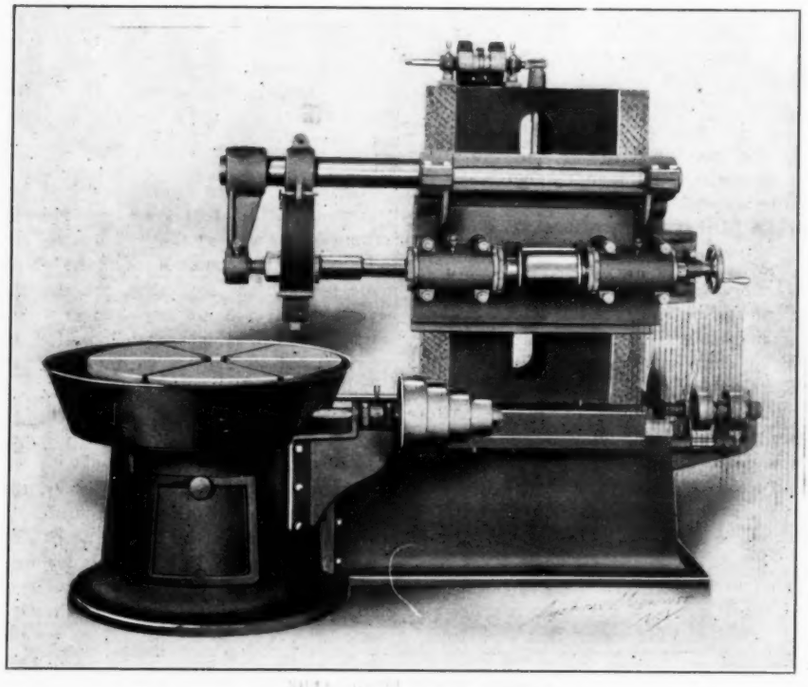


FIG. 1. ROTARY SURFACE GRINDER.

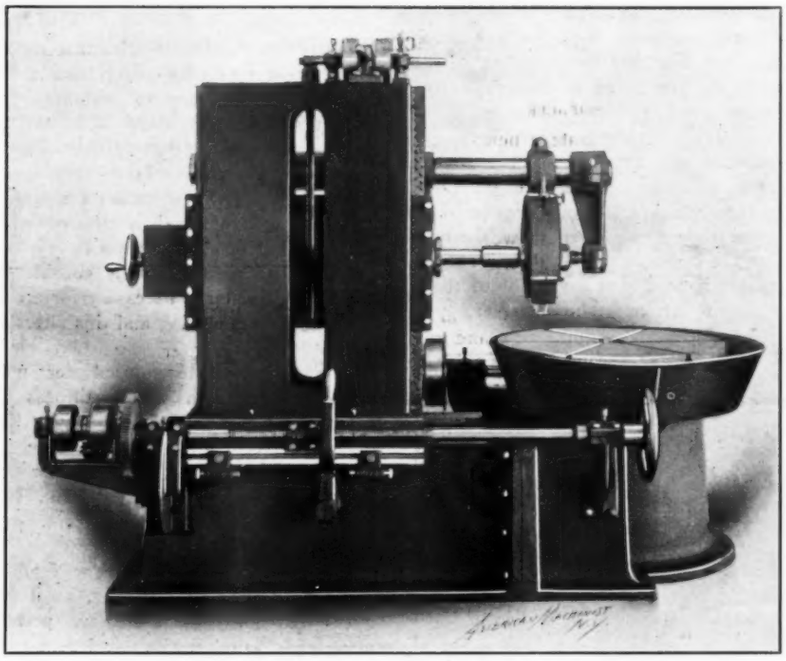
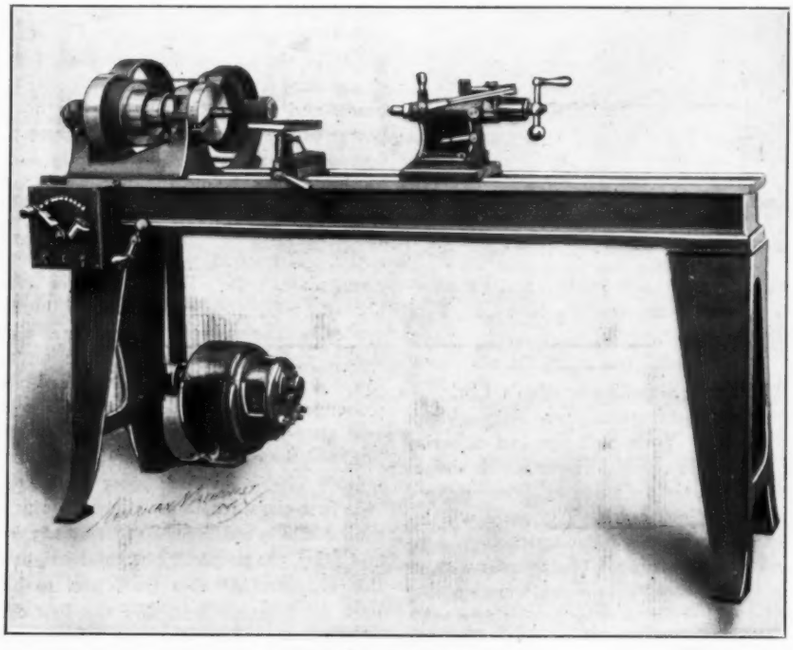


FIG. 3. ROTARY SURFACE GRINDER.

countershaft has an 18-inch drum, 24 inches long, and is driven by 10x10-inch tight and loose pulleys. The counter for driving the table has a cone corresponding to the one on the worm-shaft below, and is driven by 6x6-inch tight and loose pulleys. The feed-motion counter has pulleys 6 inches diameter by 3 inches face for operating the feed-screw and an 8-inch drum, 28 inches long, for raising the head. It is driven by tight and loose pulleys 18 inches diameter, by 4 inches face. The idler for tightening the wheel-driving belt has drums 8 inches diameter by 28 inches face. The machine weighs, with counters, 7,435 pounds, and is built by the Safety Emery Wheel Company, of Springfield, Ohio.

A MOTOR-DRIVEN SPEED LATHE.

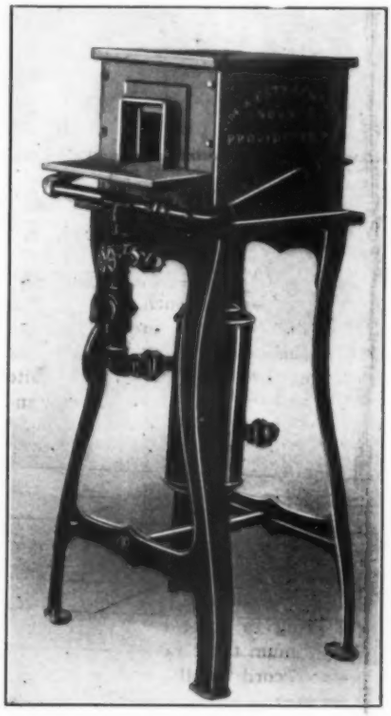
The illustration shows a motor-driven speed lathe. The motor is of the constant-speed type, and is set on the floor or on a suitable bracket and belts to a pulley which drives a countershaft at the back of the lathe head. This shaft runs in bearings, mounted upon a swinging frame which is hinged to the back of the lathe and is provided with a screw operated by a ball handle at the front to tighten or loosen the belt—which runs from the cone pulley on the countershaft to the cone pulley on the head spindle—as desired. The headstock of this lathe may be placed with the small step of the cone nearest the tailstock, as shown, or with the large step of the cone nearest the tailstock as is usual with speed lathes. The tailstock is arranged with screw and lever feed. The speed variations are the same as when the lathe is driven from a countershaft overhead. It is made by the J. G. Blount Company, Everett, Mass.



A MOTOR-DRIVEN SPEED LATHE.

THE "NOVO" FURNACE.

The half-tone shows the "Novo" gas-blast furnace for hardening high-speed steel tools, such as lathe and planer tools, short end mills, etc. The principal feature

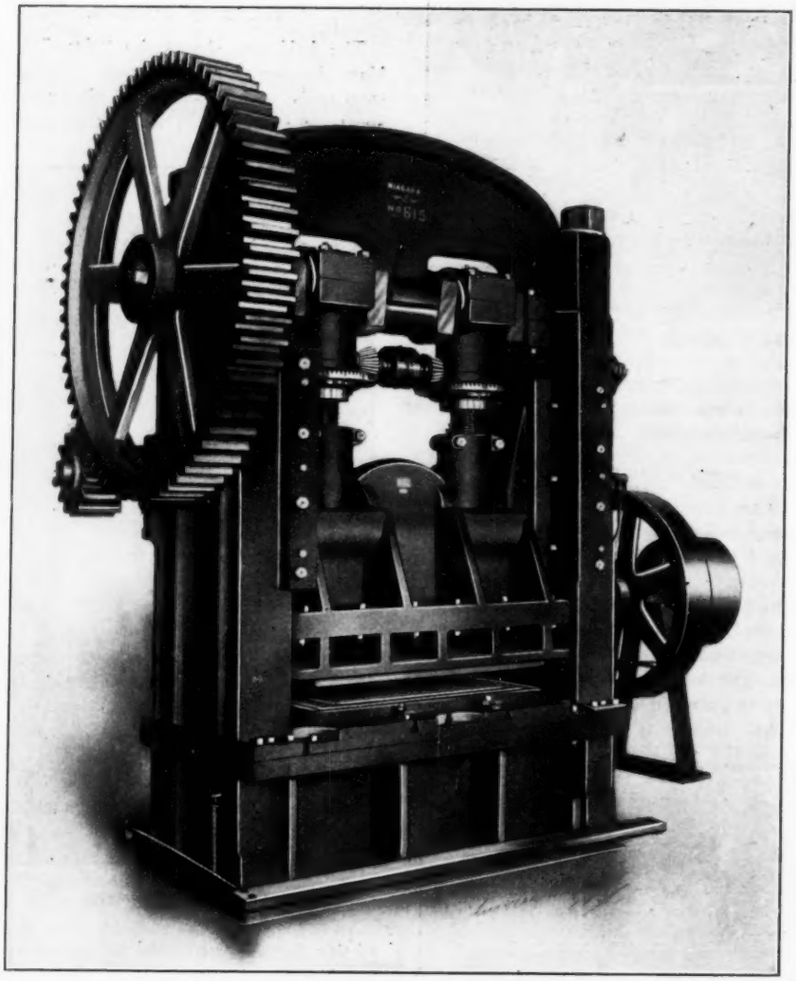


THE "NOVO" FURNACE.

of this furnace lies in the arrangement of the burners, which feed the flame from the top of the furnace, so that it heats quickly and uniformly, without any one spot in the furnace being unduly affected by the heat. The furnace is provided with heavy lining and is so constructed that long bars can be heated at any point for cutting off or forging, and when open at both ends, makes a neat brazing furnace. When operated with about one pound pressure of air, it will heat up in about fifteen minutes sufficiently to harden high-speed tools as noted above. Several sizes of this type of furnace are manufactured, the one forming the subject of the accompanying illustration being known as the "Novo" No. 2. J. M. Westmacott Company, Providence, R. I., are the makers.

DOUBLE-CRANK POWER PRESS.

The accompanying illustration shows a large and heavy double-crank power press especially designed for embossing sheets of steel, such as ceiling and siding plates, etc. On account of its ample proportions and the power exerted, the machine will produce sharp impressions. The construction is of the built-up type, the frame consisting of separate castings for bed, uprights and crown-piece. Four steel rods, 4¾ inch diameter, pass through the uprights, and take up the entire strain. The



DOUBLE-CRANK POWER PRESS.

rods are secured by heavy forged nuts, and, if desired, they can be shrunk in place. The shaft is a heavy steel forging, 8 inches diameter in the bearings, 9½ inches in the crank pins and 9 inches in the center. The uprights are 32 inches wide and 9 inches thick over all. The machine is back geared at a ratio of 30 to 1. The speed is so regulated that the operators can remove and feed the sheets between two strokes without stopping the motion of the slide. Adjustment of both pitmans is made at the same time by means of a reverse ratchet motion, the ratchet being located between two collars, each carrying a pawl, and the two pawls engaging the ratchet in opposite directions, one being used for raising the slide, and the other for lowering it. The motion of the press is controlled by a friction clutch, operated either by a foot-treadle or by means of a hand-lever. By depressing the foot-treadle, the shaft is caused to make a complete revolution, and the slide will stop when again reaching the highest point. By using the hand-lever the operator can start and stop the machine instantly at any point of the up or down stroke. The complete press weighs about 45,000 pounds, and its builders are the Niagara Machine & Tool Works, of Buffalo, N. Y.

The West Side Young Men's Christian Association, of 318 West Fifty-seventh street, New York, will conduct a series of classes the coming winter which should prove of particular value to those engaged in the building trades. The work will include general building construction, estimating and drafting. The courses will include the work of the various building trades and promise to be particularly practical and useful. The first session opened October 2.

Antimony in Bronze Mixtures.

Tin is now so high in price that we find many brass foundries going back to the addition of antimony to certain bronze mixtures to cheapen them. The practice consists in replacing part of the tin in the mixture by antimony. To be sure, spelter is also used, but there are certain cases in which a bronze metal is desired which shall be hard and stiff and yet have a good color. The addition of a considerable quantity of spelter is necessary for accomplishing the same thing and this alters the color too much.

A favorite mixture, used for many classes of work in which stiffness and color are required, is the following: Copper, 88 per cent. or 10 pounds; zinc, 5.50 per cent. or 10 ounces; tin, 2.75 per cent. or 5 ounces; lead, 2.25 per cent. or 4 ounces; antimony, 1.50 per cent. or 3 ounces.

While we are not in favor of adding antimony to bronze mixtures, as it produces red-shortness, there are perhaps, many ornamental castings such as buckles or similar cheap work in which an "Oreide" color is desired and the price of which will not afford the use of much tin. We advise those who are not acquainted with these mixtures to try them on a small scale before going ahead, as it may not suit their case. Do not use for any work requiring much strength.—*The Brass World.*

The New Cunarders.

The *Practical Engineer,* of London, gives the following particulars regarding the two immense ships now building for the Cunard company:

An unusual amount of interest is attached to the two new turbine-driven liners now being constructed for the Cunard company. The new Cunarders are to be the largest ships yet built, measuring 800 feet in length, with 88 feet beam, and 60 feet in depth. The horsepower of the four turbines aggregates 75,000, and the speed will reach 25 knots an hour, 23.5 being the present record. The double bottom of the hull leaves a space of 5 feet 6 inches between the two shells. The great width of the ship accommodates the Scotch boilers four abreast, while leaving plenty of bunker space in the wings. There are eight decks, and an important feature on the lower deck, devoted largely to third-class passengers, is the subdivision into separate state-rooms. This deck is at waterline, and the cabins will be lighted by portholes. The main and upper decks provide first-class accommodation. The great dining saloon measures 80 feet by 125 feet, and seats 500 people. The total height of this eight-storied ship from keel to boat deck is about 90 feet, and the first-class state-rooms are 50 per cent. larger than usual. Passenger elevators will work from

the orlop, or lowest deck, to the promenade deck. The motive power consists of four sets of turbines, with an indicated horse-power of 18,000 each. They will be placed on the same platform, the propellers of the inside pair being located forward of the rudder, as usual, and the propellers of the outer pair forward of the inner pair, the great beam of the ship allowing of this construction. The boiler power is of a capacity of 75,000 horse-power, which would give a speed of 25 knots with reciprocating engines. Judging from the favorable results given by the steam turbines on the cruiser "Amethyst," which exceeded all anticipation, we may expect to find these fine ships make an average of 25 miles an hour from port to port under favorable conditions.

According to despatches from Pittsburg, the New York, New Haven & Hartford Railroad has placed an order with the Westinghouse company for twenty-five electric locomotives. These are to be of the single-phase alternating-current type. Each locomotive will weigh 75 tons and will be capable of maintaining a scheduled speed of 26 miles an hour in local service with a 200-ton train, making stops from 2.2 miles and reaching a maximum speed of 45 miles an hour between stations. In express service a speed of 50 to 70 miles an hour can be maintained with a train weighing 250 tons. For handling heavier loads two or more locomotives can be coupled together and handled from the forward cab. The locomotives will have four motors each, developing 400 horse-power, or a total of 1,600 horse-power.

Personal.

Kenneth B. Thornton, a past president of the Canadian Electric Association, who has been for several years in different departments of the Royal Electric Company, of Montreal, and the Montreal Light, Heat & Power Company, has been appointed operating engineer of the Canadian White Company, of Montreal.

Obituary.

Edward L. Bartlett, a member of the firm of Bartlett, Hayward & Co., iron founders, of Baltimore, died Sept. 29, in that city, aged 59 years.

Richard A. Healy, head of the engineering department of the J. C. Todd Works, Paterson, N. J., died September 26, sixty-six years old. He was born in London and came to the United States about forty years ago.

Captain A. B. Lecato, prominent in Atlantic coast shipping and who commanded wrecking expeditions which successfully floated many stranded vessels on this coast during the last twenty years, died Sept. 24 in Norfolk, Va., as the result of ptomaine poisoning. Captain Lecato was for many years with the Merritt Wrecking organization and the Merritt & Chapman Derrick & Wrecking Co., and was wrecking agent and captain of the wrecking steamer "Rescue."

William P. Appleyard, superintendent of equipment of the Pullman company, was run over and killed by a train in Chicago, September 19. He was forty-eight years of age and entered the service of the Pullman company about twenty years ago. He left that company in 1895 to become master car builder of the New York, New Haven & Hartford Railroad, and resigned the latter position in January, 1904, to return to the Pullman company as superintendent of equipment.

Thomas Maher, a pioneer Cleveland foundryman and one of the first and foremost manufacturers of car wheels in the country, died at his home in that city September 24. He was born in Ireland, came to this country about fifty-six years ago, learned the molder's trade, and shortly after went into the foundry business, in the firm of Bowler, Maher & Brayton, making car wheels and doing general foundry work. He retired from active business about two years ago.

Manufacturers.

The York (Pa.) Silk Company will build another mill.

The Malleable Iron Works, Erie, Pa., will erect a new shop.

R. E. Thompson, Wilson, La., expects to erect an ice plant.

Ball Brothers, Muncie, Ind., are erecting a new bottle factory.

Mayo & Son contemplate enlarging their woolen mill in Foxcroft, Me.

The American Brewery, Baltimore, Md., is erecting a new bottling plant.

The Nebraska Seed Company, Omaha, Neb., will erect a $16,000 warehouse.

The Illinois Steel Company will erect a big addition to its plant at Joliet, Ill.

Los Angeles (Cal.) Art Organ Company will move its factory to Hoboken, N. J.

The Bridgeport (Conn.) Brass Company will make two additions to its plant.

The Cincha Stopper Company, New Brunswick, N. J., is erecting a new factory.

The Crescent Commission Company, Jonesboro, Ark., will build a new warehouse.

The Niagara Malting Company, Buffalo, N. Y., will erect a big, new malt-house.

The United States Paper Box Company, Philadelphia, Pa., will erect a new plant.

The Sunnybrook Distillery Company, Louisville, Ky., will erect two new warehouses.

The Toledo-Massillon Bridge Company, Toledo, O., will erect its new plant in the spring.

The Union Twist Drill Company, Athol, Mass., has let the contract for its new factory.

The Minneapolis (Minn.) Steel & Machinery Company will build an addition to its plant.

Reid Brothers, Bellingham, Ala., whose boiler works were burned some time ago, will rebuild.

The Wait-Fuller Cabinet Company, East Portsmouth, O., is having plans drawn for a new factory.

The Kansas Portland Cement Company, of Iola, Kan., will build a branch plant at Independence, Kan.

The Atchison, Topeka & Santa Fe Railroad has broken ground at Argentine, Kan., for a new ice plant.

The plant of the Anchor Silver Plate Company, St. Paul, Minn., was destroyed by fire; loss, $150,000.

The plant of the Reliable Varnish Works, Brooklyn, N. Y., was destroyed by fire; loss, about $25,000.

The Austin Manufacturing Company, Hartford, Conn., making baking pans, etc., will move to Berlin.

The Climax Fuse Company, Hartford, Conn., whose plant was recently destroyed, has decided to rebuild.

The Western Canada Milling Company, Montreal, has contracted for six large buildings as a flouring plant.

The Barnes Manufacturing Company, Jersey City, N. J., sash, blinds, doors, etc., will erect another building.

The Ayvard Manufacturing Company, Hoboken, N. J., making water-wings, will erect a new $12,000 factory.

Fire damaged the plant of the Featherstone Foundry & Machine Company, Chicago, Ill., to the extent of $150,000.

The Hendrick Manufacturing Company, Carbondale, Pa., maker of perforated metals and oils, will enlarge its plant.

The Plymouth Cordage Company, of North Plymouth, Mass., has closed contract for the erection of a plant in Welland, Ont.

The Lake Superior Corporation, Sault Ste. Marie, Ontario, will erect a large coke plant in connection with the steel-rail mill.

The Animal Trap Company will move from Abington, Ill., to Detroit, Mich., where two new factory buildings will be erected.

The Knox Wood Fiber Plaster Company, Knoxville, Tenn., has let contract for a new mill to replace the one recently burned.

Contractors are figuring on the $400,000 cotton plant to be erected by the Lawton Manufacturing Company at Plainfield, Conn.

The Arkansas Fertilizer Company, whose plant at Batesville was destroyed by fire some time ago, will erect a plant in Little Rock, Ark.

The Hudson (Mich.) Manufacturing Company will erect a new building, which will be equipped with new engines and electric generators.

Plans have been completed by the Pittsburg & Lake Erie for the erection of new repair shops at Glassport, Pa., to cost about $100,000.

The Healey Furniture Company, Sheffield, Ala., is making preparations to enlarge its plant, and will erect a planing mill in addition thereto.

The International Machine & Screw Company, Springfield, Mass., organized last December with a capital of $500,000, is now looking for a factory site.

The Denver & Rio Grande Railroad Company will erect a new thirty-stall roundhouse at Burnham, Colo. This will be equipped with all the latest devices.

The Brunswick-Balke-Collender Company, of Chicago, Ill., has acquired property in Long Island City, on which the company will erect a large billiard table factory.

It is reported that the Minnesota Sugar Company, whose plant at St. Louis Park, Minn., was recently burned, will establish its main plant in Glencoe, Minn.

The South Side Warehouse & Terminal Company, Pittsburg, Pa., will erect another building, to cost $125,000, and which will be used as a cold-storage house.

The National Envelope & Papeteries Manufacturing Company, recently organized, with an office in the Equitable Building, Baltimore, Md., will shortly erect a plant.

Through the efforts of W. L. Raeder, president of the Board of Trade, Wilkesbarre, Pa., a motor car factory, giving employment to 256 men, will be located there.

Plans are being drawn for a new factory for the Omaha (Neb.) Casket Company, to take the place of the one blown down some time ago. It will cost $30,000.

E. M. Barnes, Schofield Building, Cleveland, O., proposes to establish a factory for the manufacture of steam engines for automobiles, probably in Springfield.

Fire partially destroyed the plant of the Niagara Falls (N. Y.) Hydraulic Power Company and also the plant of the Pittsburg Reduction Company at that place.

The sawmills of the Oregon Fir Lumber Company and the St. Johns Lumber Company, at St. Johns, Ore., which were burned a short time ago, will be rebuilt.

Fire destroyed the shops and damaged the roundhouse at the yards of the Baltimore & Ohio Railroad in Parkersburg, W. Va. They will be rebuilt on a larger scale.

The Western Steel Car & Foundry Company, of Chicago, Ill., will rebuild the malleable cast iron foundry destroyed by fire some years ago at Anniston, Ala.

C. M. Miley, president of the Springfield (Mass.) Rubber Company, has closed a contract with the Lima (O.) Progressive Association for a rubber factory there.

The Wolverine Automobile & Commercial Vehicle Company has been organized, and will locate in Dundee, Mich. Harmon J. Hunt, of Detroit, Mich., is a large shareholder.

A franchise to construct and operate a gas plant in Alma, Mich., has been granted to H. G. Bedford, who is connected with the Michigan Trust Company, Grand Rapids, Mich.

The Smith Drug Company has been organized at Syracuse, N. Y., with a capital of $25,000. A factory will be established. H. E. Chase, B. E. Robinson, Syracuse, directors.

The Wire & Telephone Company of America has awarded the contract for the erection of its new plant at Rome, N. Y., to James Stewart & Co., of 135 Broadway, New York.

The Pennsylvania Steel Tie Company has filed an application for a charter. W. W. Mechling, Jacob E. Smith, Frederick Howden, all of Homestead, are named as incorporators.

The county commissioners are considering the best means of heating and lighting the county buildings, at Bowling Green, Ohio, and it is probable will have a new plant erected.

Frederick Bergner & Co., Baltimore, Md., whose plant recently burned, will erect a new building, to contain all the latest improvements for the manufacture of fancy cases, etc.

Application for charter will be made by the National Electric Time Switch Company, of McKeesport, Pa., to manufacture a novel clock invented by C. Gus Nylander, of that city.

The Gloversville (N. Y.) Textile Company will erect a factory in North Tonawanda, N. Y., and, when finished, will move to the latter place. The factory will employ 300 hands.

The American Tube & Stamping Company, Bridgeport, Conn., will make extensive additions to its plant. The plans call for additions to the billet mill, shear shop and boilerhouse.

The Calvin Manufacturing Company, organized by E. A. Smith and A. H. Washburn, of Charlotte, N. C., and T. G. Cox, of Taunton, Mass., has secured a charter for a $300,000 mill.

The Wilcomb Machine Company, to manufacture knitting machinery, is being incorporated at Norristown, Pa. Incorporators. J. Frank Boyer, Charles Kohler, J. Frank Wilcomb and others.

The Home Metallic Refrigerator Company has been formed at Albert Lea, Minn., to manufacture ice-chests, of which Dr. De Vaux, of Chicago, and L. De Vaux, of Albert Lea, are the inventors.

The county commissioners at St. Paul, Minn., have directed County Auditor Krahmer to advertise for bids for the building of a refrigerator plant at the morgue, at an estimated cost of $1,240.

Kahlenberg Brothers, Two Rivers, Wis., manufacturers of gas engines and power boats, will make extensive improvements to their plant, which will include a new powerhouse and engine-room.

The Lewanee Manufacturing Company has been incorporated at Adrian, Mich., the active promotors of which are John E. Hensey and A. R. Boyd. The company will manufacture wire fence, looms, etc.

The Union Twist Drill Company, of Athol, Mass., has let contracts for an addition to its works, which will consist of a one-story brick building, 60x180 feet. It is hoped to have the building completed this fall.

The Peerless Granite Company, a concern recently organized at North Bergen, N. J., will erect a $10,000 factory for the manufacture of laundry tubs. John Haas, Henry Fotis, John Haag, incorporators.

The Christopher Brick Machine Cleaning Company has been incorporated at Paterson, N. J., and will erect a plant there. It will manufacture a machine invented by Max T. Christopher, of East Orange, N. J.

Miscellaneous Wants.

Advertisements will be inserted under this head at 25 cents a line each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Caliper cat. free. E. G. Smith, Columbia, Pa.

Punches & dies. Wal.M.Wks., Waltham, Mass.

Wire and sheet metal working machinery and tools. Emmons Collins, Chicago.

Will buy or pay royalty for good patented machine or tool. Box 282, AMER. MACH.

Working drawings, tracings. Geo. M. Mayer, M. E., 1131 Monadnock, Chicago, Ill.

Light and fine mach'y to order; models and elec. work specialty. E. O. Chase, Newark, N. J.

Working drawings made for everything. "Cushman," 303 Broadway, Cambridge, Mass.

Dies and tools for sheet metal designed and constructed; estimates. J. V. Woodworth, 367 Vernon ave., Brooklyn, N. Y.

Wanted—Patented specialties of merit to manufacture and market. Power Specialty Co., 500 Washington ave., Detroit, Mich.

Wanted—A 1,000 lb. second-hand steam drop hammer, in good order. M. F. Williams Mfg. Co., 2,701 No. B'way, St. Louis, Mo.

Work wanted for a Cleveland automatic lathe; handles 2 in. and under. The Earle Gear & Machine Co., 141 Oxford st., Philadelphia.

Established firm wants additional metal articles, tools or machines to manufacture; will buy desirable business, patent or idea. Address Box 139, AMERICAN MACHINIST.

Clock work and intricate mechanical instruments; meter counters, water, gas or electric; recording devices; special movements to order. D. S. Plumb, 57 E. Park st., Newark, N. J.

Wanted.—An up-to-date and hustling brokerage agency wants the agency for a number of good, reputable manufacturers of machine and electrical supplies and appliances. Address S. B. Schlaudecker Co., Erie, Pa.

Wanted.—A hustling agency in the East wants to handle any good, reputable article that can be guaranteed to purchaser. We know how to sell and can show effects. Address Box 615, AMERICAN MACHINIST.

Any good special machinery or patented device, to sell or manufacture, or New York or Eastern agency for high-class manufacturer, wanted by reliable, hustling, well-informed concern. Beemer & Co., Irving Bldg., New York.

Mechanical engineer of ability lately filed application for patent for an entirely new machine; industry for which it was invented anxiously awaiting the marketing of same; would like to correspond with parties desiring to control and manufacture a meritorious and profitable machine. Box 662, AM. MACH.

For Sale.

New 10-horse "Advance" gasoline engine, never uncrated, with 30 in. clutch pulley, at wholesale price. D. C. Giles, 418 Euclid ave., Elmira, N. Y.

For Sale—One "Garvin die slotter"; never been used at all; in A1 condition; for description, see Catalogue No. 11, page 11, Garvin Machine Co. Box 375, AMER. MACHINIST.

Business Opportunities.

Financial assistance to patent useful and original novelty in bicycles. M. H. L., care AMERICAN MACHINIST.

Wanted—A shop to build by contract machine weighing 4,000 lbs.; first-class work required. Address, giving information regarding equipment, Box 653, AMER. MACHINIST.

Wants.

Situation and Help Advertisements only inserted under this head. Rate 25 cents a line for each insertion. About six words make a line. No advertisements under two lines accepted, and no advertisements abbreviated. The cash and copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded; but replies will not be returned. If not forwarded they will be destroyed without notice. Original letters of recommendation or other papers of value should not be enclosed to unknown correspondents. Only bona fide situation want or help want advertisements inserted under this heading. Agency advertisements must be placed under Miscellaneous Wants.

Situations Wanted.

Classification indicates present address of advertiser, nothing else.

CONNECTICUT.

Mechanical engineer, several years' experience as draftsman and designer, wishes position. Box 646, AMERICAN MACHINIST.

Wanted—Position by a competent man, to take charge of small factory or act as assistant; drafting, designing tools, and economical production thoroughly understood. Box 660, AMERICAN MACHINIST.

MASSACHUSETTS.

Experienced mechanical draftsman, 27, German, technical graduate, wants to change position. Box 649, AMERICAN MACHINIST.

Foreman, large experience in all kinds of edge tools, agricultural implements; first-class machinist and toolmaker. Address "Foreman," care AMERICAN MACHINIST.

NEW JERSEY.

Foreman machinist, practical mechanic with varied experience, college and drafting-room training, desires position. Box 661, AMERICAN MACHINIST.

Machinery Salesman—Position by thorough mechanic; educated in scientific salesmanship, practical demonstrator and expert on automatic machinery. Address Box 665, AM. M.

Position as draftsman wanted by mechanical engineer, 26; 3 years' experience, last 2 with leading firm in pumping machinery; references; location immaterial. Box 645, AMERICAN MACHINIST.

NEW YORK.

Experienced cost clerk desires position. Box 559, AMERICAN MACHINIST.

Mechanical draftsman wishes position. Address Box 640, AMERICAN MACHINIST.

Mechanical draftsman, having 8 years' experience, desires position. Box 663, A. M.

Mechanical draftsman desires position; experience 7 years; shop 4 years. Box 664, AMERICAN MACHINIST.

Experienced automobile draftsman wants position; technical graduate. Address Box 659, AMERICAN MACHINIST.

Position as assistant superintendent with manufacturing concern; references furnished. Box 621, AMERICAN MACHINIST.

Superintendent or manager, age 35, thorough mechanic, desires position; A1 references. Box 607, AMERICAN MACHINIST.

A successful manager of a manufacturing machine and foundry company is now open for an engagement. Box 654, AMER. MACH.

Mechanical engineer, A1 draftsman, wants steady position with good concern; 7 years' drafting and shop experience; New York city wanted. Box 647, AMERICAN MACHINIST.

Foreman, experienced in erecting and testing gas and gasoline engines, desires change;

good executive and mechanical ability; excellent references. Address Box 637, AM. M.

Machine designer, technical graduate, 11 years' experience, engines, pumps, printing presses, automobiles, screw machinery, etc., is open for engagement. Box 656, AM. M.

Wanted—A position as superintendent or general foreman, by a thorough, up-to-date mechanic; 20 years' experience in the machine-tool and automobile business. Address Box 597, AMERICAN MACHINIST.

Wanted—Position, superintendent, foreman or toolroom foreman, by superintendent with wide practical experience; technical education; expert tool designer; location immaterial. Box 599, AMERICAN MACHINIST.

Graduate engineer, age 30, desires position as chief draftsman, engineer, leading designer; 2 years' shop, 8 years' office experience as draftsman, inspector, leading designer on special and small machinery, instruments, jigs, fixtures, gages; inventive, hustler, and bound to win; salary $135 to $150. Box 622, A. M.

In Greater N. Y. or vicinity, the superintendency or mechanical supervision of some good, progressive manufacturing establishment, by a man of rare abilities and exceptional qualifications, in the prime of a healthy life (38 years of age); heavy, medium or light manufacturing; practically familiar with all details of mechanical production of to-day; a cost-reducer and systematizer and all-round expert in the factory; have an absolutely clean record, with exceptional executive ability and long experience. Unless you mean business and are willing to pay a salary commensurate with value received, do not answer this. Address Box 634, AMER. MACH.

OHIO.

Specialist in milling and grinding operations and general time-saving methods; A1 tool designer and maker. Box 440, AM. M.

Position as foreman, by live, energetic man; systematic and up to date; can handle men smoothly and efficiently. Address Box 657, AMERICAN MACHINIST.

PENNSYLVANIA.

Mechanical and architectural engineer and draftsman is open for engagement; Corliss engines, blowing and pumping engines, gas engines, power stations; competent to take charge. Address Box 630, AMER. MACHINIST.

Practical draftsman on light machinery, 34 years old, 6 years on special machinery, 12 years in shop and drawing on jig and fixture work, well up on cheap methods of manufacturing, capable of taking charge, would like to get in small, growing shop; best of reference. Box 642, AMERICAN MACHINIST.

Help Wanted.

Classification indicates present address of advertiser, nothing else.

CANADA.

Wanted—Draftsman, experienced in design of tools, jigs and fixtures. Address Box 644, AMERICAN MACHINIST.

Wanted—General draftsman; one familiar with turbine water-wheel, sawmill and pulp mill machinery design; state age and experience. Apply to Box 650, AMER. MACHINIST.

CONNECTICUT.

Wanted—First-class blacksmith, accustomed to machine forging and use of steam hammer; state age and wages expected; none but first-class men need apply. Box 623, AM. MACH.

ENGLAND.

Draftsman wanted in British works of old-established engineering firm, to design mainline and other locomotives, and best classes mining machinery, engines, pumps, etc.; must have sound theoretical training as well as practical experience with above mentioned work; must be capable for ready and accurate calculations; must have capacity to take charge; state experience fully, also age and salary expected. Address B. D., care *Railway Gazette*, Queen Anne's Chambers, Westminster, London, S. W., England.

ILLINOIS.

Feed and speed foreman for a machine shop employing 75 machinists on large and small machine tools; man with energy and aggressiveness wanted; state age, past experience and salary desired. Box 567, AMER. MACH.

Foreman for sheet metal works in Chicago, capable of taking charge of shop employing 100 to 200 men, and working from No. 27 iron up to ¼ plate; must be up to date, familiar with all sheet metal working tools, able to lay out; in answering, state past experience, present occupation, wages and reference. Address Box 643, AMERICAN MACHINIST.

INDIANA.

Experienced office men, draftsmen, foundry chemist, foremen, stock, departmental and cost clerks, and mechanics for large concern with rapidly growing business, including foundry, machine shops and sheet metal and wood-working departments; high-grade work, including automobiles. Box 413, AM. MACH.

MASSACHUSETTS.

Wanted—One first-class planer hand; references required. Union Twist Drill Co., Athol, Mass.

Wanted—Competent and experienced cost clerk and organizer, looking for permanent opening in charge with large concern in metal trades line; write full particulars, age, references, experience, salary and where now employed. Box 87, Springfield, Mass.

NEW JERSEY.

Lathe, planer and boring mill operators wanted for night shift; those accustomed to machine tool work preferred; steady work and good pay to good men. Address the Pond Machine Tool Co., Plainfield, N. J.

Wanted—Several first-class diemakers on high-grade work; sub-press diemakers preferred; steady work and good wages for good workmen; no labor trouble. Sloan & Chace Mfg. Co., 297 Washington st., Newark, N. J.

Wanted—At once, two first-class turret lathe operators, capable of demonstrating to customers the capabilities of the Pond rigid turret lathe; good pay to good men; none but first-class mechanics in this line need apply. Appress Pond Machine Tool Co., Plainfield, N. J.

Foundry foreman; must be good molder and capable of handling about 25 men on medium weight machine tool castings; one familiar with both floor and molding machine work; state age, experience and wages expected; foundry located within 10 miles of New York city. Box 655, AMER. MACHINIST.

NEW YORK.

Wanted—A1 toolmakers, thoroughly experienced in jig and tool work. The General Pneumatic Tool Co., Montour Falls, N. Y.

Wanted—Draftsmen, experienced in design of jigs and fixtures, also dies for light interchangeable work; state experience and terms. Address Box 648, AMERICAN MACHINIST.

Wanted—Two good toolmakers on sheet brass and copper, stamping, drawing and nurling tools; state wages and experience. Apply or address Rome Mfg. Co., Rome, N. Y.

Wanted—Several A1 mechanical draftsmen; only those having had 3 or more years' practical experience need apply. Engineer in Charge, Drafting Department, General Electric Co., Schenectady, N. Y.

Wanted—Foreman for machine shop employing about 15 men on steam engine work; new shop and tools; in small town; state whether married or single, wages asked, and give references. Address Box 652, AM. M.

Wanted—Immediately, several expert designers, experienced in designing jigs, dies and fixtures for small machine manufacture, also first-class toolmakers for the same work. Address P. O. Drawer No. 7, Syracuse, N. Y.

Wanted—Superintendent with experience in the manufacture of first-class machine tools; must be energetic, with good executive ability; technical graduate preferred; an excellent opportunity for the right man; state age and past experience. Address "Machinery Manufacturer," care AMER. MACHINIST.

OHIO.

Wanted—Designers and detailers on heavy machine tool work; state age and experience. The Niles Tool Works Co., Hamilton, Ohio.

Wanted—Machine shop foreman, by a company in the Middle West, manufacturing gas engines and electrical apparatus; must be steady, willing to take hold and hustle, and thoroughly posted in modern machine shop pactice; a good, permanent position to the right man. Box 651, AMER. MACHINIST.

PENNSYLVANIA.

Vise hands or fitters on machine tool work; modern shop; no trouble; applicants should state past experience. Standard Engineering Co., Ellwood City, Pa.

Wanted—Two first-class, experienced machinists at once, for tool and jig work; must be accurate workmen. Address "X. Y.," care AMERICAN MACHINIST.

Wanted—A first-class draftsman; preferably one who is familiar with motor and controller work. Address, giving experience, Ridgway Dynamo & Engine Company, Ridgway, Pa.

Foreman to take charge of modern equipped machine shop; 100 men; must be accustomed to modern methods of rapid production in a miscellaneous class of work; reply promptly, giving age, experience and salary expected. Address "X. Y.," care AMERICAN MACHINIST.

WEST OF MISSISSIPPI.

Clarinet or 'cello player wanted for small pleasure orchestra; permanent employment for first-class mechanical draftsman or good warehouse stock clerk; location, Tennessee. Address Box 658, AMERICAN MACHINIST.

WISCONSIN.

Wanted—Experienced operators for Jones & Lamson and Gisholt turret lathes; also experienced toolmakers. Address Box 606, A. M.

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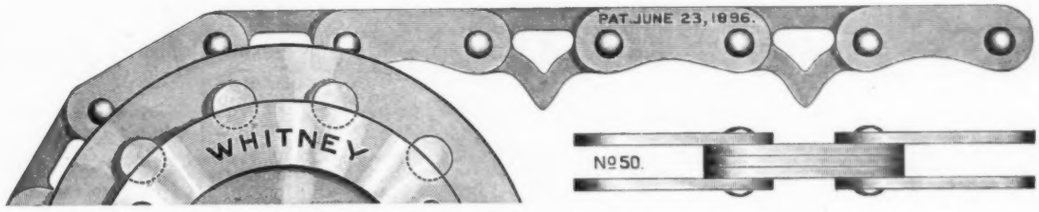

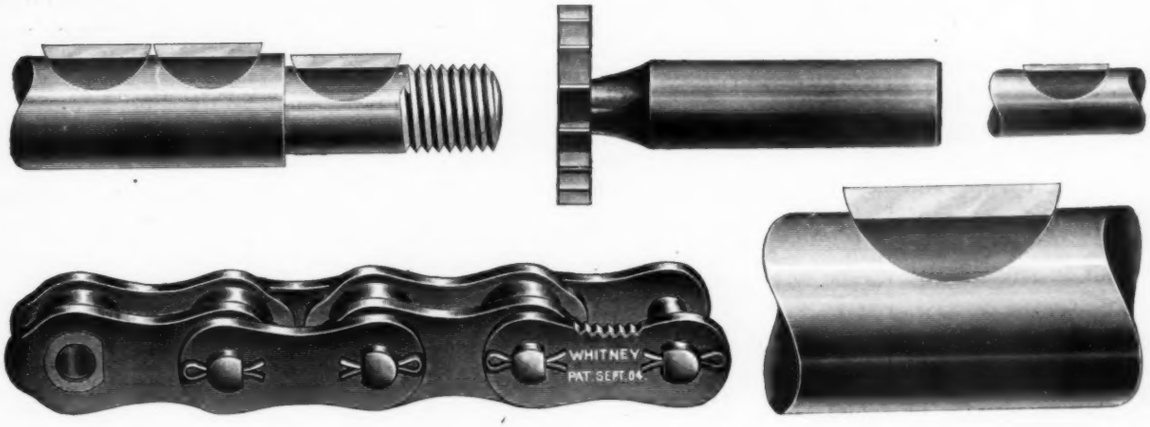

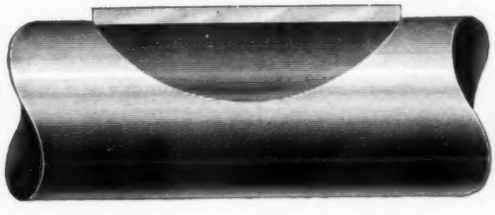

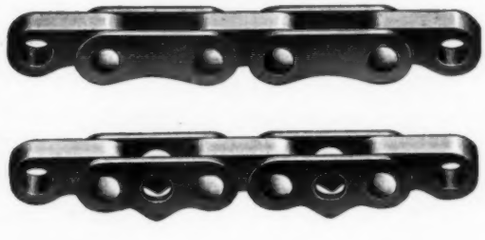

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Foote, Burt & Co., Cleveland, O.
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Garvin Mach. Co., New York.
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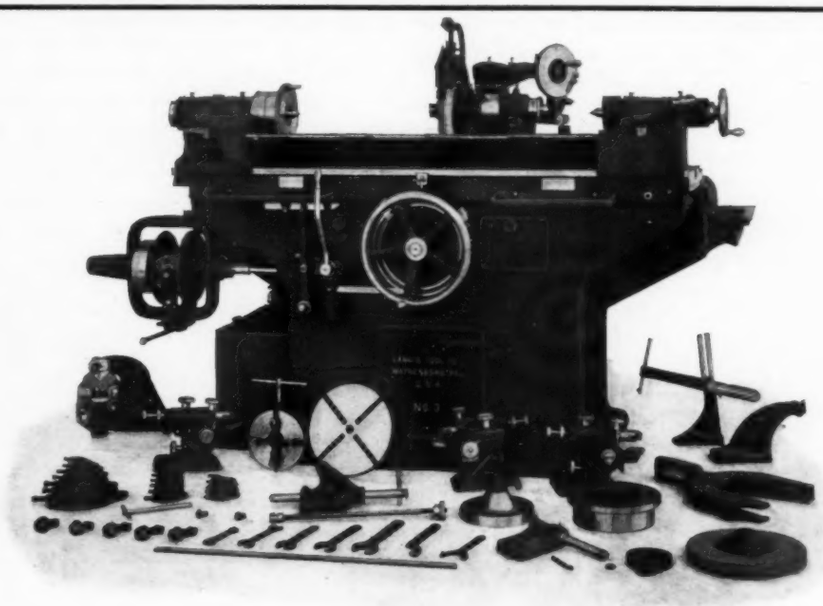

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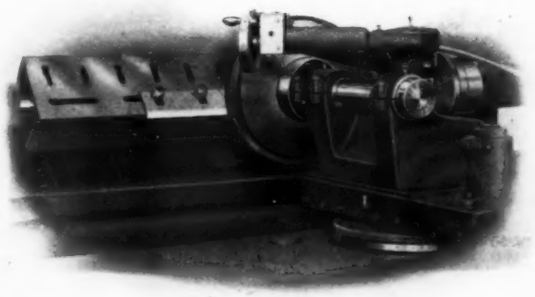

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A Pacific Coast Engine.

EDITORIAL CORRESPONDENCE.

The accompanying illustrations show some of the features of a triple-expansion engine having cylinders of 36, 58 and 90 inches diameter by 48 inches stroke, which has just been completed by the Union Iron Works, of San Francisco, although, as shown standing on the erecting-shop floor in Fig. 1, it still lacks a few of the finishing touches. It was built for the San Francisco Gas & Electric Company, is intended to drive an alternating-current generator of 3,500-kilowatt capacity and will be seen to be of the marine type throughout; in fact, but for its governor and the absence of reversing gear, there is little to prevent its being placed in a ship and doing satisfactory service.

All cylinders have piston valves, increased valve area for the intermediate and low-pressure cylinders being obtained by increasing the number instead of the size of the valves. Thus the high-pressure cylinder has a single 24-inch valve, while the intermediate has two and the low-pressure cylinder four of 22 inches diameter. The general arrangement of these valves is shown in the side elevation, Fig. 2. The two for the intermediate cylinder are located upon one side, while the low-pressure cylinder

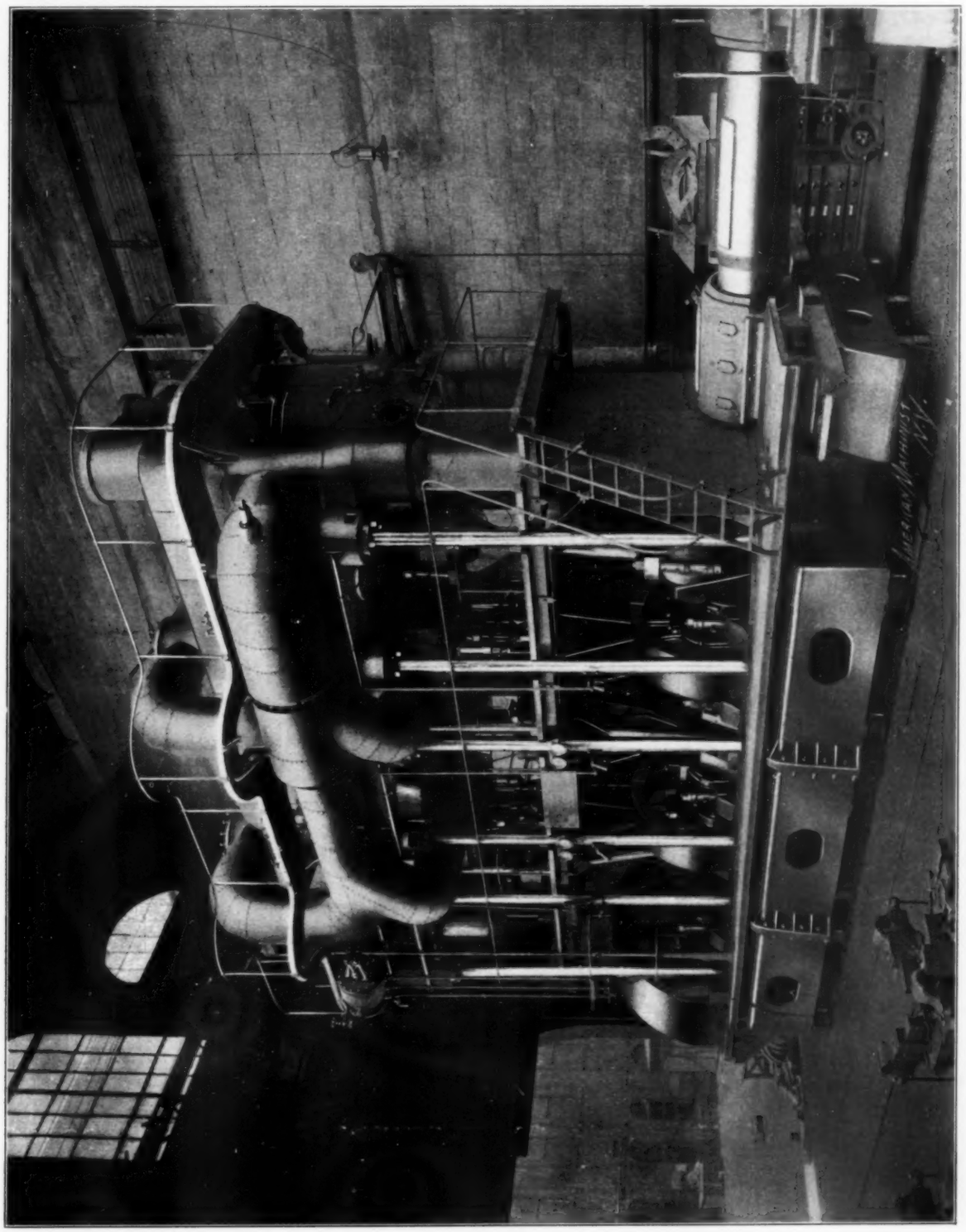


FIG. 1. A PACIFIC COAST ENGINE.

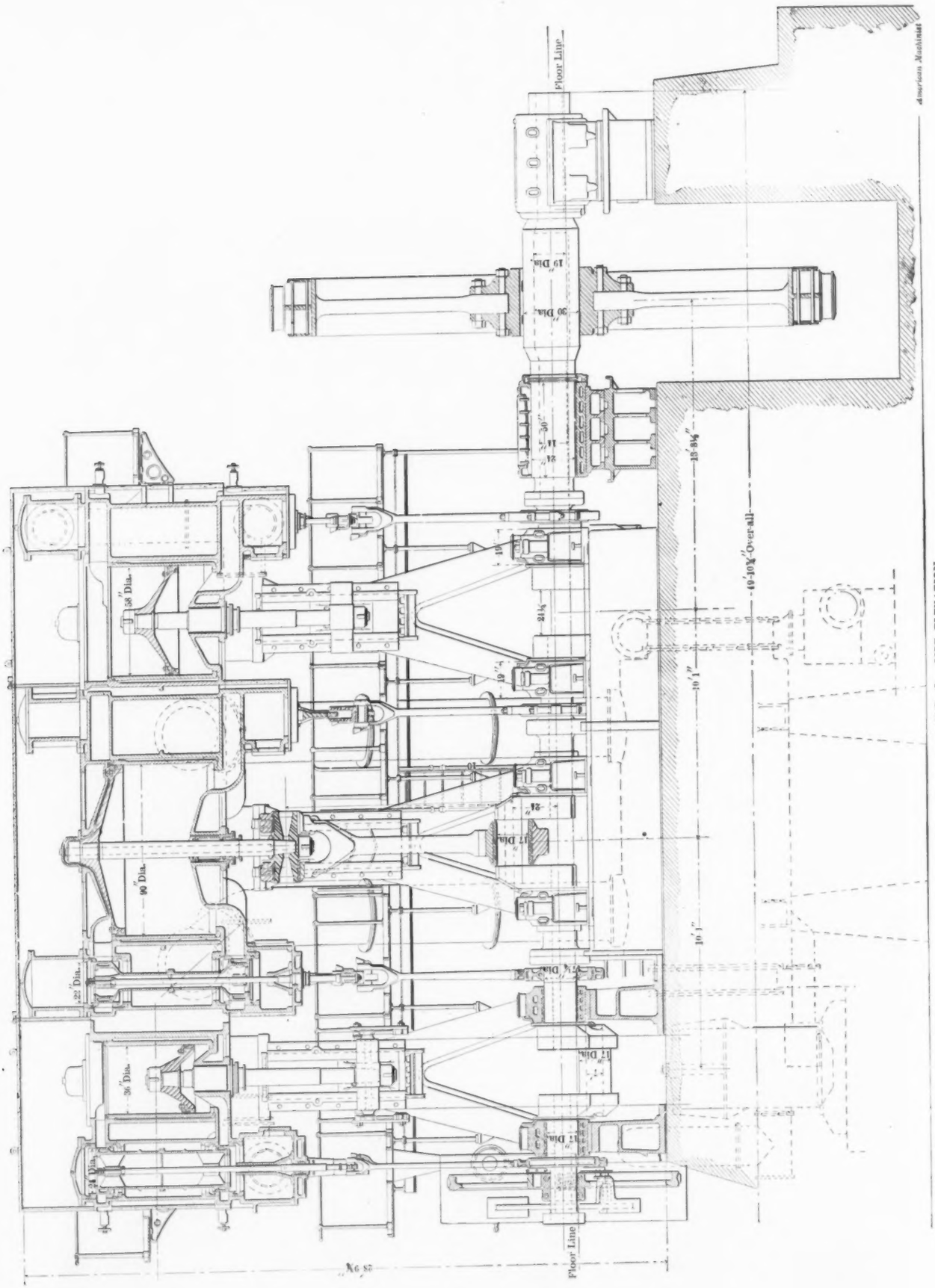


FIG. 2. SIDE ELEVATION.

has two upon each side, each pair having its own eccentric and rod. Each pair is driven through a yoke connection, shown in the end elevation, Fig. 3, and more detailed in Fig. 4. The crosshead *a* surrounds the guide bracket *b*, which latter has a deep inverted V-notch at its bottom, across which the pin is placed. The design of the valves, with their bushing seats, is shown in Fig. 5. The object of the deep circumferential recesses *a a* is to facilitate heating of the seats and thus diminish distortion. The admission of steam by the high-pressure valve is by its inside and by the intermediate and low-pressure valves by their outside edges.

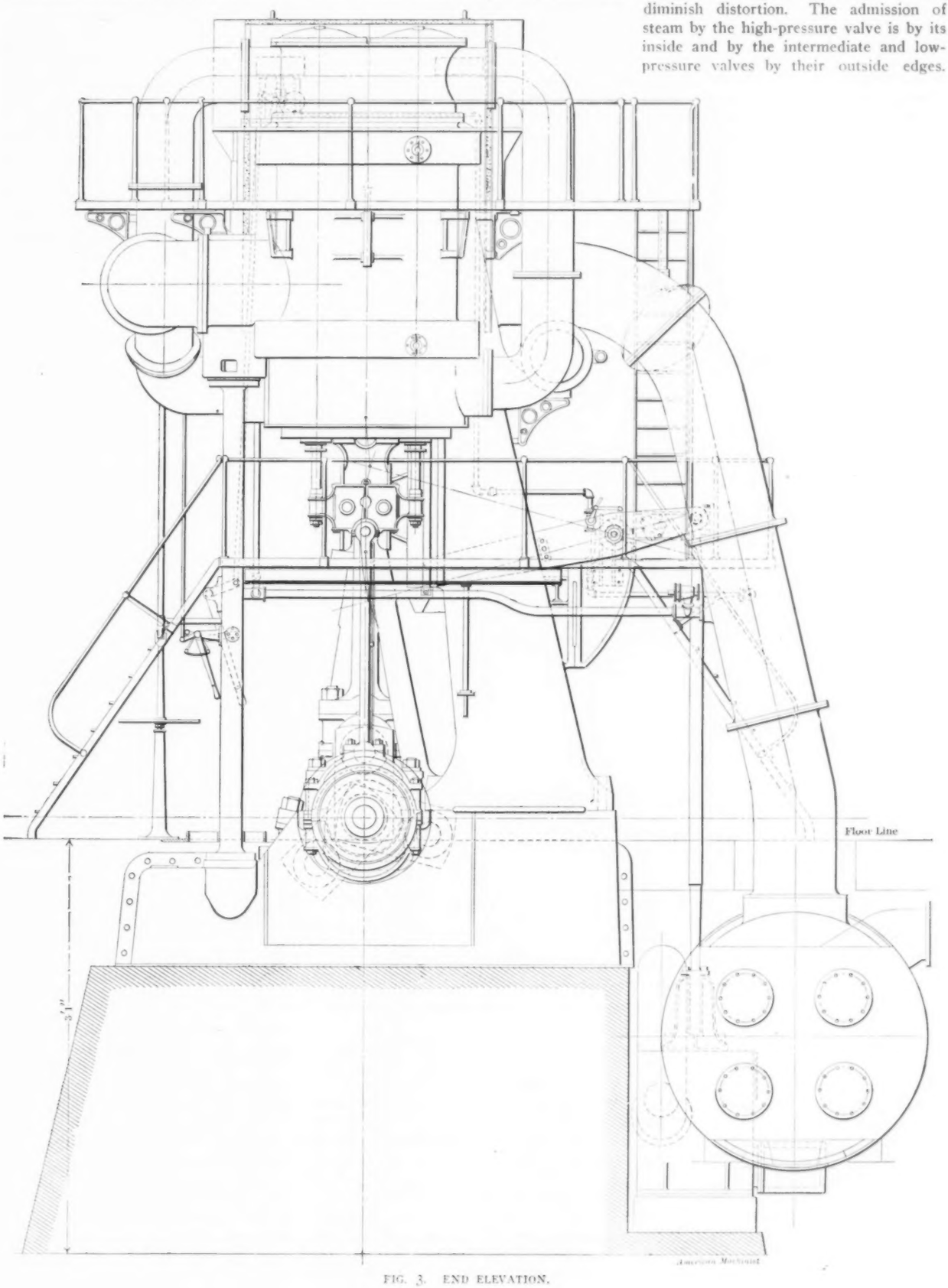


FIG. 3. END ELEVATION.

Th rings forming the valves proper are split and have tongue pieces—not shown—in the joints.

The throttle valve has an ingenious provision to facilitate opening against steam pressure and without increasing the liability to leakage which is inherent in all forms of balanced valves. The valve is shown in Fig. 6. It is operated by the shaft *a*, which is turned by a hand wheel, shown attached thereto in the left foreground of Fig. 1. Right and left-hand threads *b c* on the upper end of this shaft operate nuts which are connected to the valve stem by the toggle-joint levers *d e f g*. In the closed position of the valve shown it is obvious that the toggle-joint action gives a powerful lifting action to the valve, and that as the valve leaves its seat and the force required is diminished the action is to reduce the force applied and to rapidly increase the speed of movement.

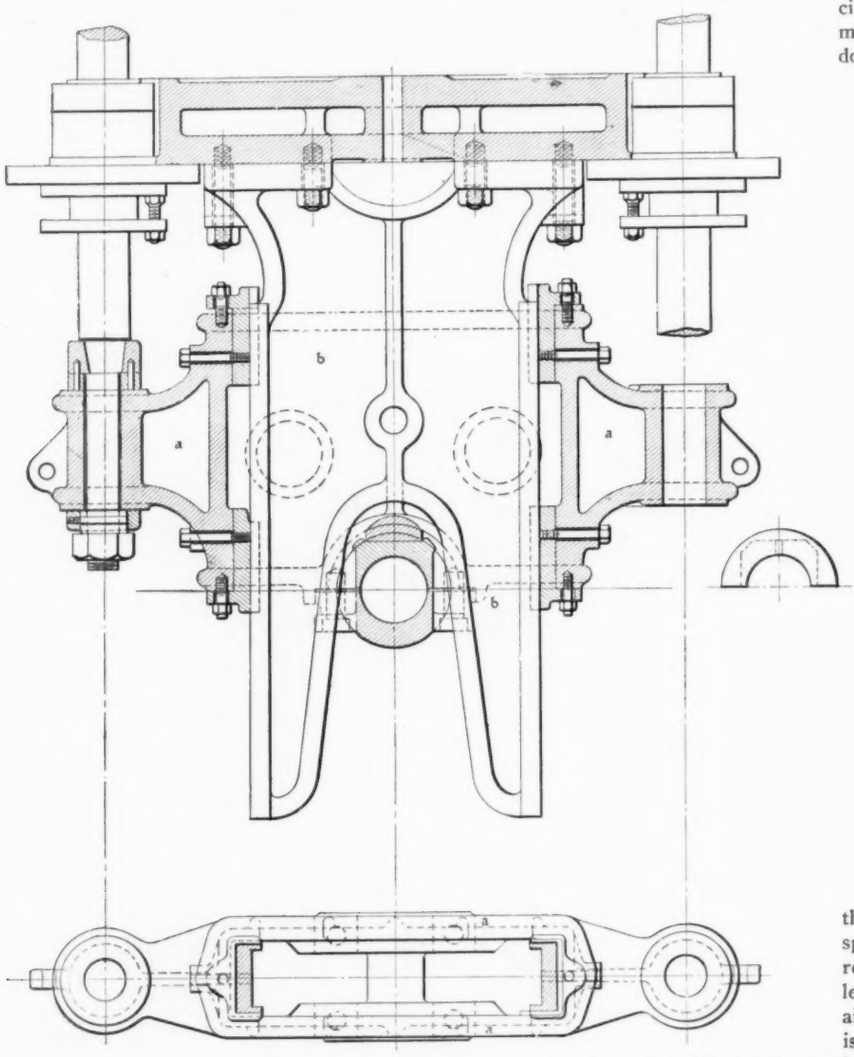
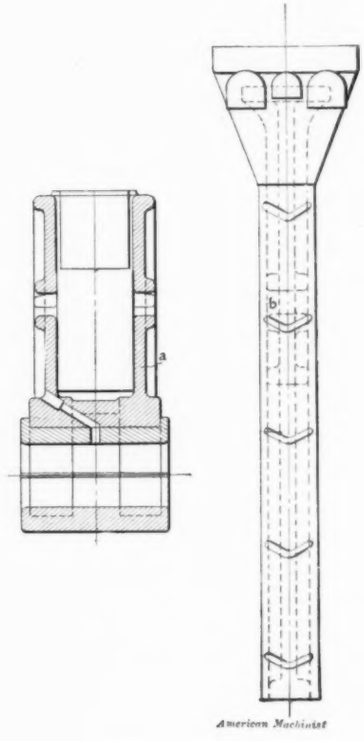


FIG. 4. VALVE CROSSHEAD AND GUIDES.

One of the most striking features of the engine is its governor, shown in Fig. 7, from which it will be seen to be of the shaft-governor inertia type and of large—almost gigantic—dimensions for a governor of this class. Its magnitude may be best judged from Fig. 1, in which its containing case is shown at the further end of the shaft, where its size may be compared with that of other things. The diameter of this case, shown from the opposite point of view in Fig. 7, is nearly 11 feet. If a shaft governor approaching this in size has been made before I am not aware of it. This governor acts upon the valve of the high-pressure cylinder only.

A special feature of the governor is the one by which the speed of the engine is adjusted to bring the generator into syncronism with others conected with it, and this also is shown in Fig. 7. Mounted upon the hub of the governor, and revolving with it, is a small motor, within which are four contact rings and as many brushes for carrying current to the motor. The motor is connected to the governor springs by a worm and segment, plainly shown in the illustration, the electrical contacts being so connected that one set turns the motor in one and the other in the opposite direction, the action of the motor on the governor springs increasing or decreasing the speed, according to its direction of rotation. The control of the motor is, of course, from the switchboard, as usual.

Fig. 8 shows the emergency governor, intended to act only under excessive speed. It is an adaptation of the English Aspinall marine governor, and acts on a very simple principle. It is mounted on the air-pump beam, with which it oscillates. A pivoted weight tends, by its inertia, to lag behind the beam and to oscillate on its pivot at each reversal of the motion, but is normally prevented from doing this by a spring. Should, however, the speed exceed the limit for which the spring is set, the weight does oscillate, thus releasing a catch which engages the bent lever, shown mounted concentric with the air-pump beam. Thus engaged, the lever is oscillated on the next stroke of the beam, the throttle valve is closed and the engine is stopped. In the illustration the weight is the elongated piece with a rounded side, located at the end of the supporting frame, its axis of rotation being parallel with the length of the beam. The adjusting spring and its hand wheel are located at the left above the weight and the catch which engages the lever at the right. The lever operates a valve, of which the lower flange is to be connected to the condenser, though not piped up when the picture was taken. The upper flange is connected by a pipe, of which the other end is shown at *a* of Fig. 9, to a



vacuum cylinder *b*, which has a cover plate *c*, which is open from the cylinder around the edge, inorder to exclude dirt and to admit air. With the connection established, the stop valve *d*, which is a supplementary-valve for this duty only, is closed. Unlike the main valve, it is balanced, because absolute tightness in it is not essential. After stoppage, the main valve is closed and this valve reopened by the water cooled. Fig. 10 shows the construction of the bearings, including the disposition of the water passages. Four passages *a b c d* are cast in the lower half of the bearing, the ribs which separate the passages having openings at alternate ends to provide a continuous flow, as indicated by arrows in the plan. The ends of the outer passages have tapped holes at *e f* for the water-pipe connections. The that no settlement of the foundation has taken place. In this illustration, lines *a b* represent the top surface of the pedestal casting, and *c d* the end jaws of the same casting. A piece of sheet steel *e* is fitted to these surfaces and has also surfaces *f g*, which, after the engine has been aligned in the shop, are fitted to contact with the shaft. With this gage it is obvious that the engineer may at any time,

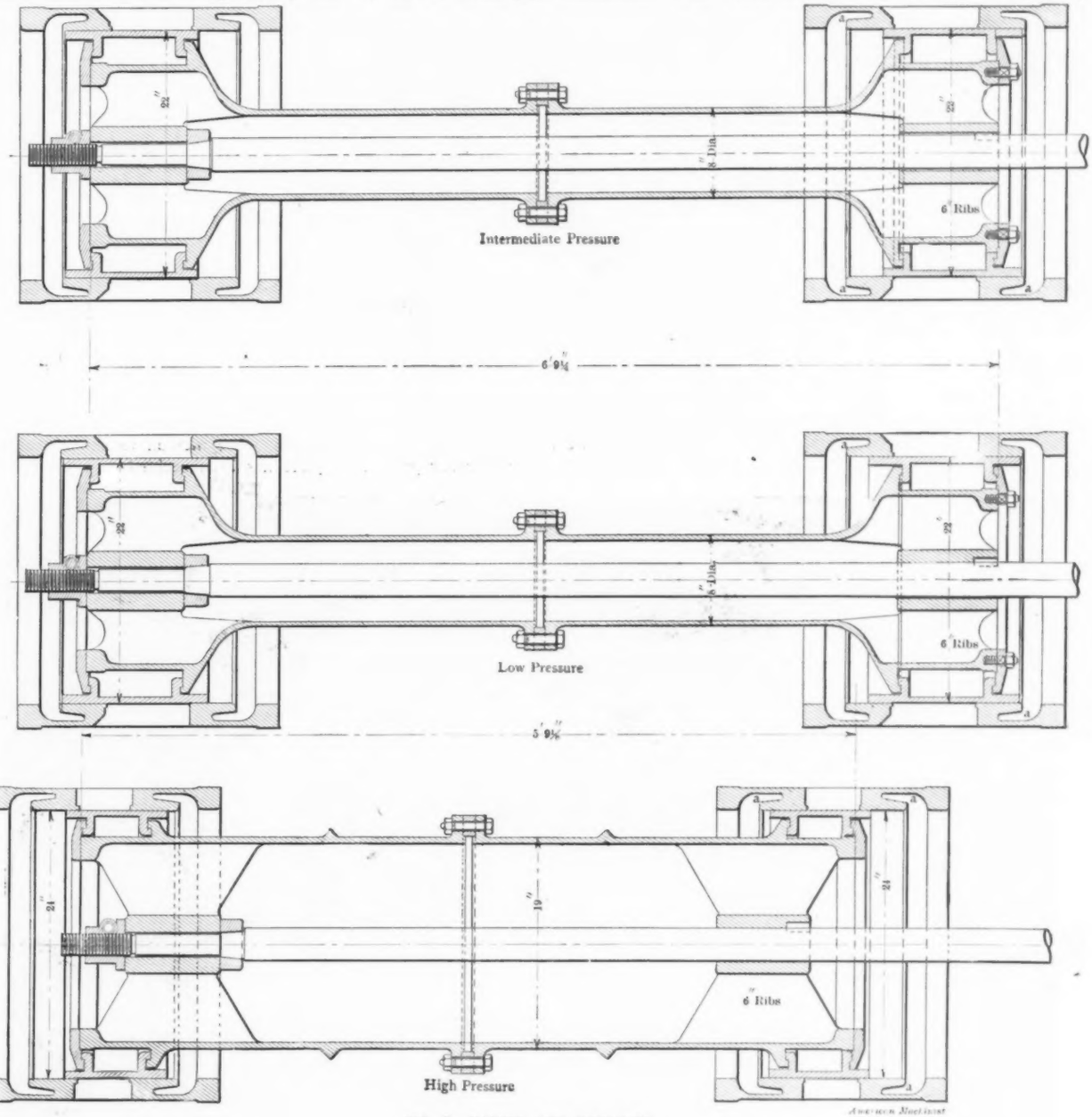


FIG. 5. VALVES AND BUSHINGS.

shaft and linkwork shown in Fig. 9, the operating hand lever being shown in Fig. 1 at the right of the main throttle wheel. A weight *e*, Fig. 9, nearly balances the valve and its levers, and as it would overbalance the levers alone, links *f g* are added to maintain contact between wiper *h* and toe *i*.

Following marine engine practice, the main bearings and crosshead slides are caps of the bearings have no water connections. The crosshead guides have similar passages, as shown in Fig. 11, except that the passages go right through the castings, pieces *a b*, with supplementary distributing passages, being bolted to the ends.

Fig. 12 shows an excellent provision for testing the alignment of the shaft and bearings after wear, the test presupposing by merely removing the caps of the bearings, apply the gage and test his bearings.

F. A. H.

The experiments in the use of oil fuel by the British navy have been so successful that the Admiralty have ordered the conversion of the wharves at Turnchapel, Plymouth, into a great storage depot for oil.

Echoes From the Oil Country—One Way at a Time in the Foundry.

The molding machines have no doubt done wonderful things in making many kinds of castings both cheaper and better, and if we are to take as entirely true everything that an eager and enthusiastic salesman may tell us, they should be used for all kinds of castings that can be made on the bench and for many that are usually made on floor. This is a view from the side of the man who has a machine to sell. The man who has the castings to make has many things to consider besides the number of molds that can be turned out from the machine in a day.

Often a foundry has a limited number of castings to make at a time of a kind. The whole output of the foundry may be quite large, but so may the variety be large, and also the demand for the castings from any one pattern may be very uncertain—so uncertain in fact that it is not safe to do much stocking up. Under such conditions one often wonders how to keep the cost down, in spite of the constant changes and the small lots called for.

After an experience with molding machines that has not been extended or varied enough to be of much value to anyone but ourselves, we have concluded that it is not our best solution under our present conditions and have fallen back on other methods. The method to use in making a piece has been decided after all of the

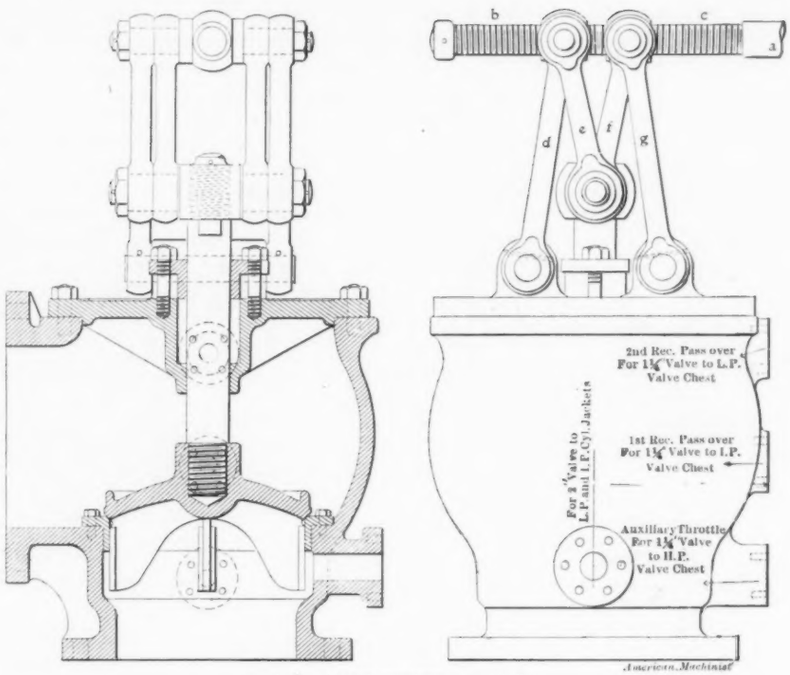

b
c
a
d
e
f
g
2nd Rec. Pass over For 1¼" Valve to L.P. Valve Chest
1st Rec. Pass over For 1¼" Valve to I.P. Valve Chest
For ¾" Valve to L.P. and I.P. Cyl. Jackets
Auxiliary Throttle For 1¼" Valve to H.P. Valve Chest
American Machinist

FIG. 6. MAIN THROTTLE VALVE.

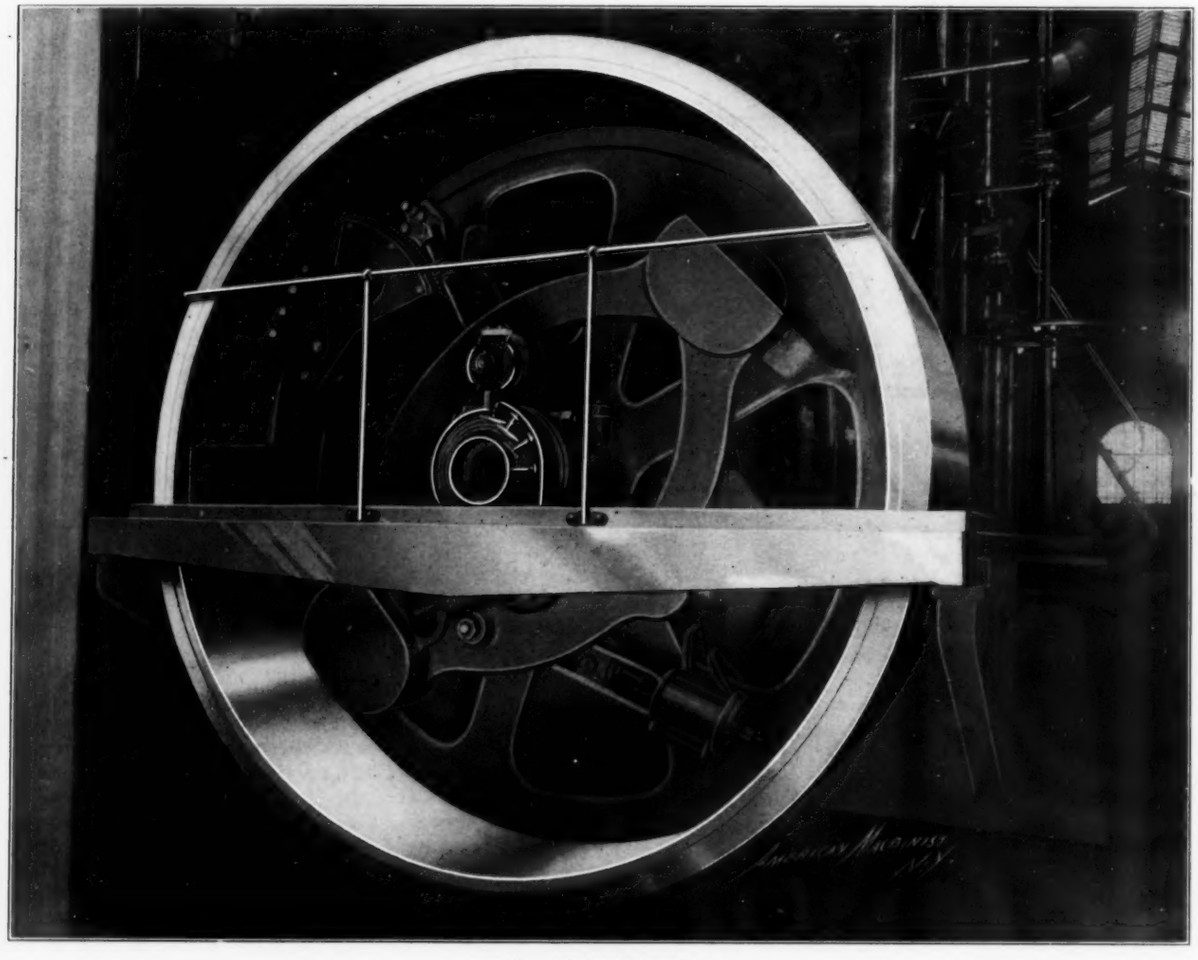


FIG. 7. INERTIA GOVERNOR.

known conditions have received careful consideration, and so the present time finds us doing things in a variety of ways. Sometimes a piece may be made on the floor because there is not enough of that size work to keep going full on, and this piece will help to round things out. This may not seem to be a very good reason to some people, but we think it as well to be able to balance up the work in the shop as to save time and expense in any other way. The time saved in having a man go right along with his work in the place where he is accustomed to be, and with the things he is familar with, is just as good as if it were saved in any other way.

It takes time to get a man started in a new place, even in the shop where he is regularly working, and it is generally easier to break a man in on a new job on his own floor than it is to do it on some other floor.

Many men never stop to think of the saving, at least in mental wear and tear, that comes from habit, and right here is a place that some foundries could make more of a saving than they do.

If I had work that it would pay to put a molding machine on, even though I did not have more than half enough work to keep it going all of the time, I would be willing to put other jobs on it so as to keep the operator busy on it all of the time, even though some of them could be done as well on the bench or on the floor; because I know that I would lose, it might be an unknown amount but a loss nevertheless, by having him part of the time away from the machine. I would not get as good results from him, either at the machine or away from it, as I would if he were all the time at only the one place.

Even the rare man who is the ideal jobbing hand and who seems to thrive on variety, has his habits which help him,

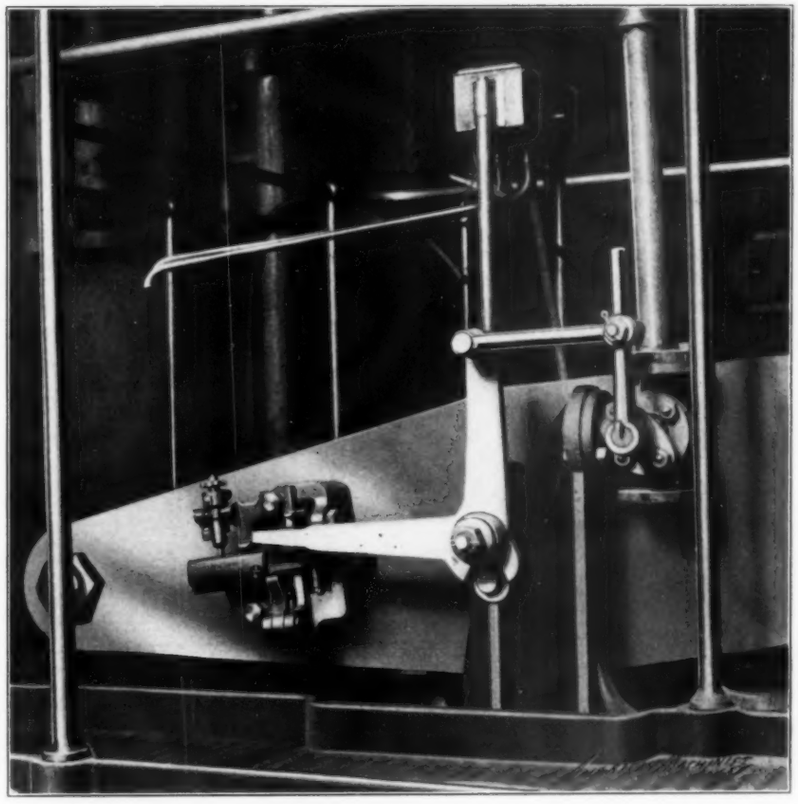


FIG. 8. EMERGENCY GOVERNOR.

and once in a while he will get a job that seems to run contrary to them and come down with a thud that will jar the "old man."

Did you ever stop to think what it is that makes you criticize the ways of the new man who comes to work beside you, or the ways of the new shop that you go to work in? Did you ever wonder why it is that the new boss wants to change so many things in the shop that he goes to, and why the men in the shop are so set against any change?

After you have thought the matter over and come to understand what the force of habit does to make or mar a man or a foundry, and have added to this the amount of the effect of human inertia, you must not fail to remember that inertia acts on the behavior of a man the same as it does on the behavior of any other body. When a body is given a motion in any direction the tendency is to keep moving in that direction, and it takes less force to keep the motion up to a certain standard in that direction than it does to change the direction and to get the same motion in another direction. If you wish to produce a very swift motion in a direction by a series of impulses and with the least expenditure of force, see that all of the impulses act in the same direction and hit the body to be moved in the exact center of gravity.

Applying this same reasoning to the foundry, apply your force to seeing that

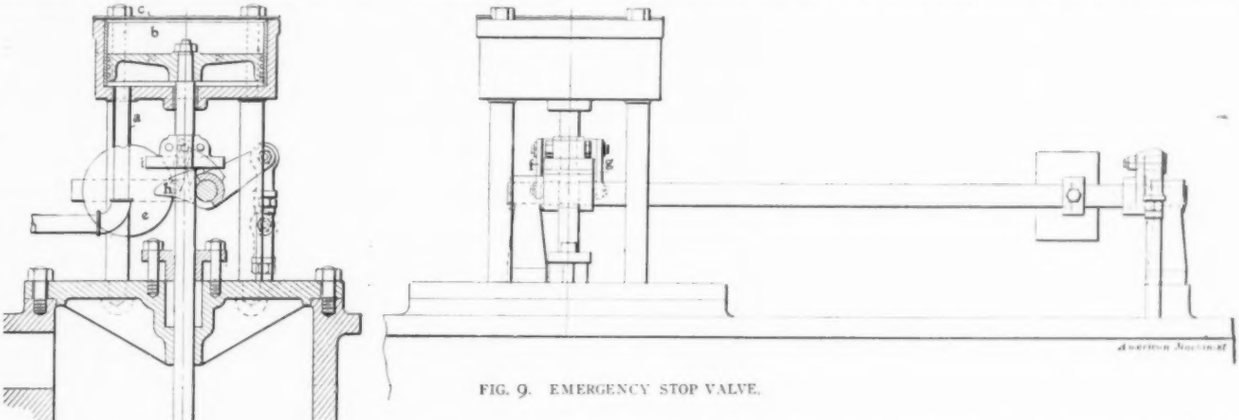


FIG. 9. EMERGENCY STOP VALVE.

the boys and men have a chance to form good habits, and see that the place has a system that helps instead of hindering; and after a system has been thought out and adopted, do not let it be lightly changed or interfered with. A good system is worth more to any foundry or any machine shop than the best machine in it.

Don't get scared as soon as you hear the word "system," and begin to think of all sorts of disagreeable things that someone in authority has tried to have you do and which you were forever forgetting the right combination on, as it means many things besides that. It means hanging your coat in the same place every day, and having your shovel and rammer where they can be reached with the least amount of thought and exertion, and always putting your trowel in the same hip pocket, and having only one place for your chewing tobacco. It also means studying the ways of your men and arranging the work as far as it can be done so that it runs with the natural tendencies of the men instead of against them. If things have to be arranged the other way, it will take a lot of breaking in to get good results, and life is too short to break in some men to very many jobs, and they may be very good men at one or two jobs for all of that.

There is another name that might be given to the kind of system that I have in mind, to distinguish it from the extensive elaborations which are called systems and which are generally disliked by the shopmen who have been tied up by them. If it were to be called "common sense," perhaps you would feel kindlier toward it; but it is system, nevertheless. I mean the kind that makes the drawing-room always use the same way in putting their projections on the paper, so that a man is sure, after the first time, which end of the plan is meant by the elevation that is at the left end of it, without looking for some dotted lines or other that are lots plainer in the drawing-room than they are in the pattern shop or in the foundry; and the kind that does not plaster the drawing so with symbols that it needs a special key to be understood, and then send it into the foundry. Just here it may be said that blueprints are no rare thing, at least in some foundries, and it is just as hard for a molder to read a blueprint with certainty as it is for a machinist to do so. I mean the kind that follows this idea all through the works and tries to arrange the little things so that they will be convenient and fall into the natural ways of the men and not go against them, when it can be done as well as not.

It is a very nice thing to have cupboards made for the men to keep their tools in, and it is well worth taking time to see that they are of proper size and shape to suit the purpose for which they are intended; but when they are provided, also try to place them in places that are convenient for the men that are to use them, and not in some place so inconvenient that it happens to be unoccupied. Even a naturally careless man will take better care of his shovel if he has a handy place to keep it, and it has a big plain mark on it to show that it is his, and he finds that the boss calls any man down who takes it away from where it belongs, the same as he gets it for having another's tools.

It is true that men see things differently, and the time will never come when men will agree that any certain way is the best one; so we must expect to find different shops being run in different ways, even

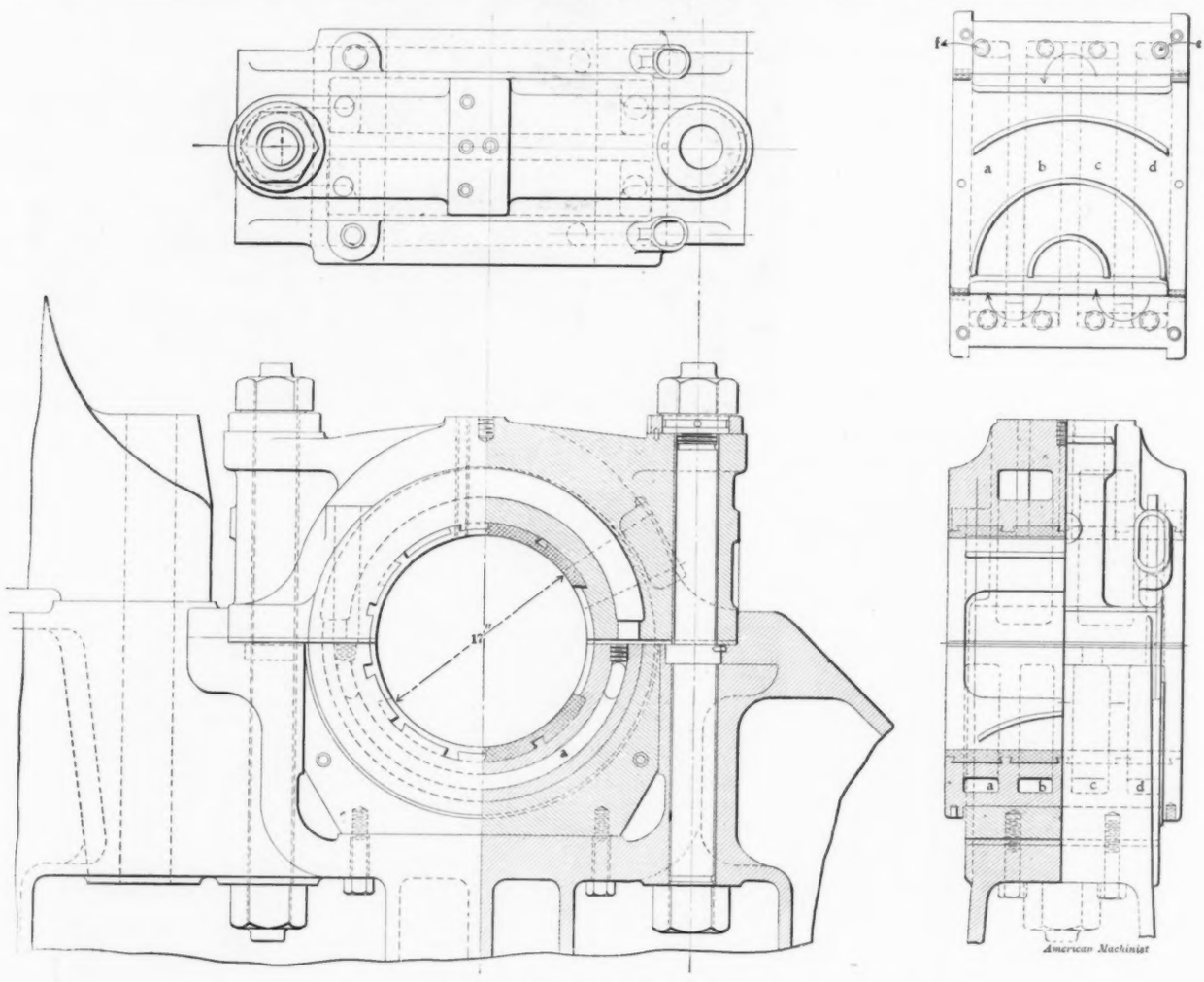


FIG. 10. WATER-JACKETED MAIN BEARINGS.

though they may be doing the same kind of work; but that is not sufficient excuse for finding all of these ways mixed up in the same shop. Things should crystallize on some one way and then be held to it, and when a change is made drop the old. Don't mix things.

It is well not to forget that the simplest system will not run itself. If a molder finds it more convenient to have the laborer who helps him do it in a certain way, he must not only instruct him, but he must keep enough pressure on to see that it is done that way and no other, and must have patience enough to keep it up on that line until the way becomes a habit with the helper. It is the same way with all of those in authority in any way, and to do this takes time and thought and self-control, and the results are well worth the effort.

W. OSBORNE.

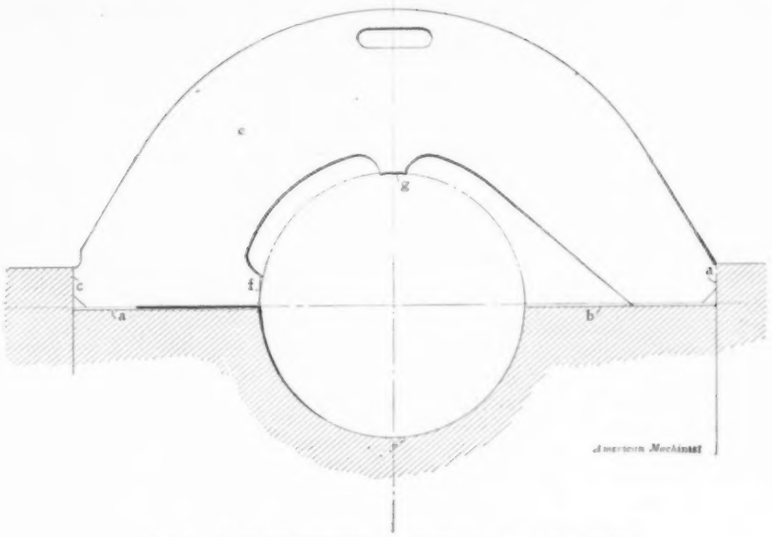


FIG. 12. GAGE FOR TESTING ALINEMENT OF MAIN SHAFT.

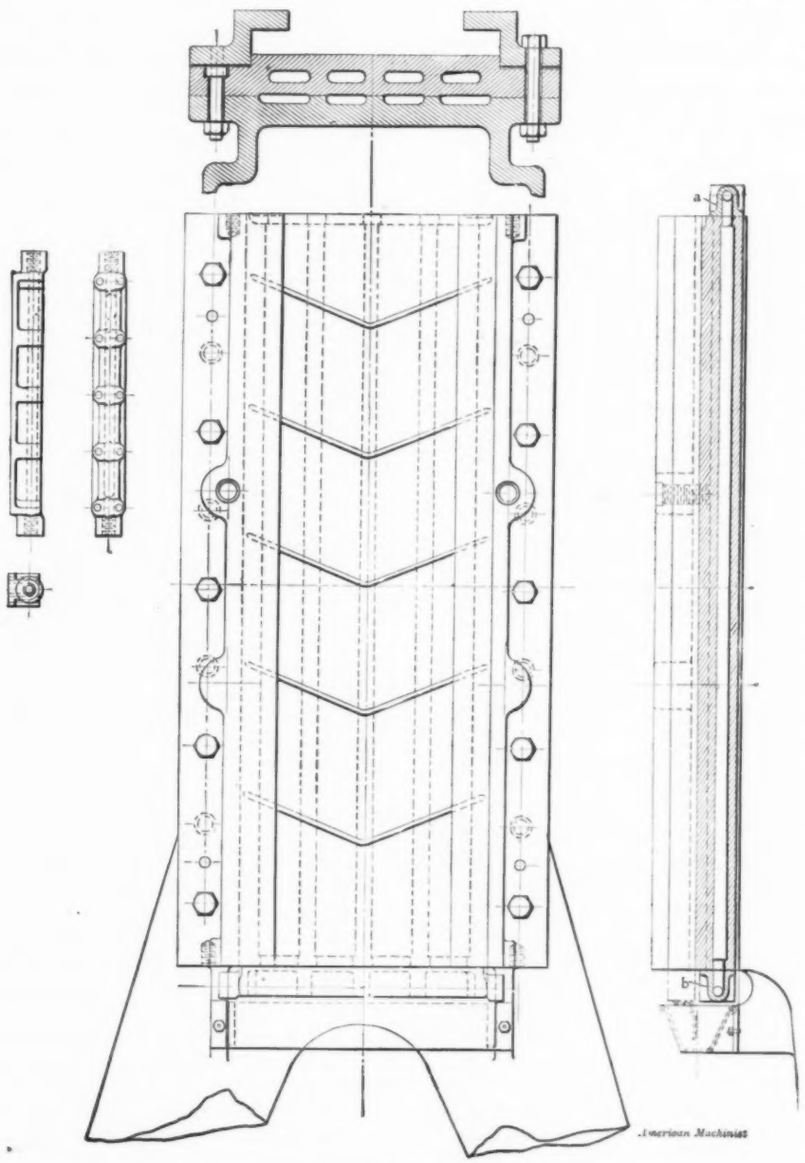


FIG. 11. WATER-JACKETED CROSSHEAD GUIDES.

College Shop Experience—VI.

BY HARRY MARQUETTE.

The room which contained the testing machines was used during the fall and winter terms as a general storeroom only, and in order to get them out of the way and still have them in a safe place, the "Prof" had arranged a good many spare pieces and tools in groups upon the floor of the storeroom. Here were the large face-plates for the lathes, some special blocks for the milling machine, and a lot of attachments for the woodworking machines, which had been used during the planing-mill days but were not needed for instruction purposes. Many of these pieces and attachments were not highly finished, and all of the working parts had been slushed with grease before putting them away.

On Saturday morning the "Prof" had been working at a sawmill down the Gulch, doing some repairs for which he was to receive lumber to make some new tables, benches and cupboards needed in the shop. Before going to work in the afternoon, he visited the shops, accompanied by two of the students who were helping him, intending to get some tools which were needed in the work at the mill.

When they reached the shop they found the back door standing open and heard a considerable racket coming from the storeroom. It sounded as though someone was trying to break up scrap iron, and so the "Prof" repaired to the storeroom in hot haste.

In the middle of the room stood "His Nibs," bossing the work of three husky students from the agricultural department, whom he had hired to help him for the afternoon. In the center of the room was a pile on which these boys were heaving all of those "greasy old castings," as "His Nibs" called them, as fast as they could. As the "Prof" entered he saw a wabble

head for the universal wood-worker heaved toward the pile, and by exercising some of his old football tactics he succeeded in catching the piece before it struck. By that time his blood was up and he demanded an explanation for this destruction of property. "His Nibs" replied, "This room has been a worry to me for a good while, and I could not see what you kept all this worthless scrap around for. The President furnished me with these boys and we have just started to clean up. By getting rid of all this scrap we would have a lot more room for useful things, and you could easily make a nice exhibition of the work of the students in this room. You see that all the pieces we have found that are any good so far are those few laid by the wall over there." The few pieces referred to were sample exercises in turning and milling which had been gotten out by the machine class. On account of the fact that at the time the shops lacked a supply of tool steel the students had turned up and milled out a number of taps, reamers, counterbores and twist drills from the shafting taken from some old broken-down agricultural machinery. In fact a large proportion of the material for the exercises in the machine shop was obtained from such scrap which was donated to the college by farmers in the vicinity. The pieces which "His Nibs" had laid up had no real value, while the pieces he was destroying were all of value. In heaving the stuff into the junk pile his ready helpers had already succeeded in doing much damage. It was not until he had been shown how a number of the pieces fitted the machines for which they were intended that "His Nibs" was willing to acknowledge that they were of any value, and even then he still insisted that they be cleared away out of the storeroom, and put in boxes or some other place out of sight.

The problem was solved some days later by the "Prof" taking some of the lumber he received for the work at the sawmill and making a set of cupboards for the attachments.

The Navy Department is erecting a space-telegraph tower 200 feet high at the Washington Navy Yard, in an effort to communicate with the wireless station at the Brooklyn Navy Yard. Heretofore messages between the two places have been sent by relay. With powerful instruments at either end, it is expected that the operators will have no difficulty in exchanging messages. The tests will begin as soon as the Washington station is completed, which will be in a few weeks.

The Rutherford Institute of the Young Men's Christian Association of Hartford, Conn., has arranged an evening course of study in steam engineering, of which the class will meet for the first time at 152 Temple street, October 3. Both elementary and advanced work will be taken up.

Lathe Design and Practice—I.

BY E. H. FISH.

In the course of a number of years' connection with the machine-tool business, nothing has struck me more forcibly than the small amount of progress which engine-lathe designers have made compared with that made by designers of other tools which are really special forms of lathes, such as boring mills, horizontal boring machines, turret lathes, etc. In fact, some lathes such as the old Wood & Light, Pond, etc., of thirty to forty years ago compare very favorably with the ordinary lathe of to-day if we can look at them fairly, forgetting mere changes of fashion. In the present-day tool there is very little difference in one respect, as all workmen are aware, and that is in the disposition to chatter. By this I do not necessarily mean that the work comes out with noticeably wide chatter marks, but with the fine "stuttering" appearance which we almost always see on roughed work.

I have had to give this subject considerable thought and at one time or another to put some of my ideas into practice. Others I have either not dared to try or have not had the opportunity.

THE CAUSE OF CHATTERING.

In considering the subject, let us first imagine the conditions of Fig. 1. In this case the lathe spindle simply rests in half boxes at *b* and *c*, is supposed to be held securely against end thrust and carries the work on centers, as shown. All that holds the spindle down is its own weight, and the weight of the cone, face gear, etc., attached to it and the weight of the work itself. The belt pull and the pressure of the tool tend to lift it. So long as the downward forces predominate at the point of the tool, there will be no chatter. Suppose, now, that the upward pressure on the tool becomes great enough to balance the remaining pressure beside what is carried by the belt. Evidently we get great possibilities in the way of chattering. If the bearings of the spindle have caps and there is any perceptible play, the result is the same. The caps keep the spindle from jumping out of the boxes, that's all. If the caps seem to be down snug and the bolts holding them are not under sufficient tension to keep them rigid, the same result will follow. Suppose we carry the pressure of the cutting tool still higher so that the belt pull and the tool pressure will keep the spindle against the top cap all the time. If the cut is uniform and the work does not start vibrating when the cut is started, and if the bolts holding down the caps, etc., are under initial tension, we may be able to avoid chattering.

This calls our attention to two points which lathe builders are apt to slight: one, the cap bolts, which are usually designed by eye to have a good-looking head, and, second, the bolts to hold the head to the bed, which are usually not designed at all.

I have seen four $\frac{7}{8}$-inch bolts to hold on the front cap and two $\frac{3}{4}$-inch to hold the front end of the head to the bed. This in turn suggests casting the head on the bed and using a solid head-bearing, with perhaps a conical box. These are both objectionable to the lathe builder, on account of the cost and because with the conical box it is hard to get a good fit on the spindle. There is no room for doubt that the easiest box to fit is the half-box, which can be so easily scraped to the spindle. It is entirely open and easy to get at with a scraper. The conical box is usually not scraped at all, reliance for a fit being placed on the accuracy of the machine work. No man who has bored and scraped a pair of lathe boxes will venture to say much for the fit of a box which is simply bored, no matter how carefully it is done.

The next best thing to casting the head on is to bolt it down with short, large, closely-fitting bolts, set up hard, and to make the head casting as heavy as possible. Money saved by coring out a headstock under the front bearing is about as near money wasted as is possible. Nothing that we can use will so surely check vibration as a mass of gray iron placed in the line of stress.

THE MAIN SPINDLE BEARING.

As to the form of box, the one shown in Fig. 2 is one which I have used and firmly believe in, though it costs something to make. The cap is heavy and is bolted down hard to the head. The adjustment of the box to the spindle is made by setting up the wedge under the lower half-box, by means of two set-screws bearing on rods which, in turn, move the wedge. This gives very nearly solid metal all around. If adjustment for alinement must be made, a liner under the cap can be used or the bearing of the cap on the head can be scraped down. It would be better if the brasses were made to be set up close to each other and then be scraped when adjustment is needed. If this is done, then there is nothing loose nor slack about the whole bearing. The above box is only good engine practice applied to engine lathes. If this box is objected to on the ground of lack of interchangeability, we may answer by referring to Fig. 3, which shows a holder to screw on the nose of a lathe spindle to hold the boxes when boring them. This fixture holds the box in exactly the same way and under the same pressure as in the lathe head, and if the workmanship of the holder is good the boxes will scrape up readily.

Of course the claim made by lathe builders who make boxes fitting in a round seat, that the alinement of the lathe can be regained if lost by making a new set of boxes, "which is only a good piece of lathe work," is to be taken with a pinch of salt, as all such boxes must

be scraped and that, almost invariably throws the bearing out of line with the boring of the head. The heads are usually planed on to the bed by using an arbor fitting the boxes so that the bore of the head is usually, in a new lathe, slightly out of line with the bed. If now we replace these boxes by new ones and scrape in a spindle and happen to make just the same error in scraping that the first builder did, then we get a good job; but if, on the other hand, we make an opposite error, it may be quite noticeable. With the square box shown it is equally, but no more possible to make an error in fitting the spindle, and as a user would not be tempted to try to replace boxes in an amateurish sort of way, possibly he would be better off to have it.

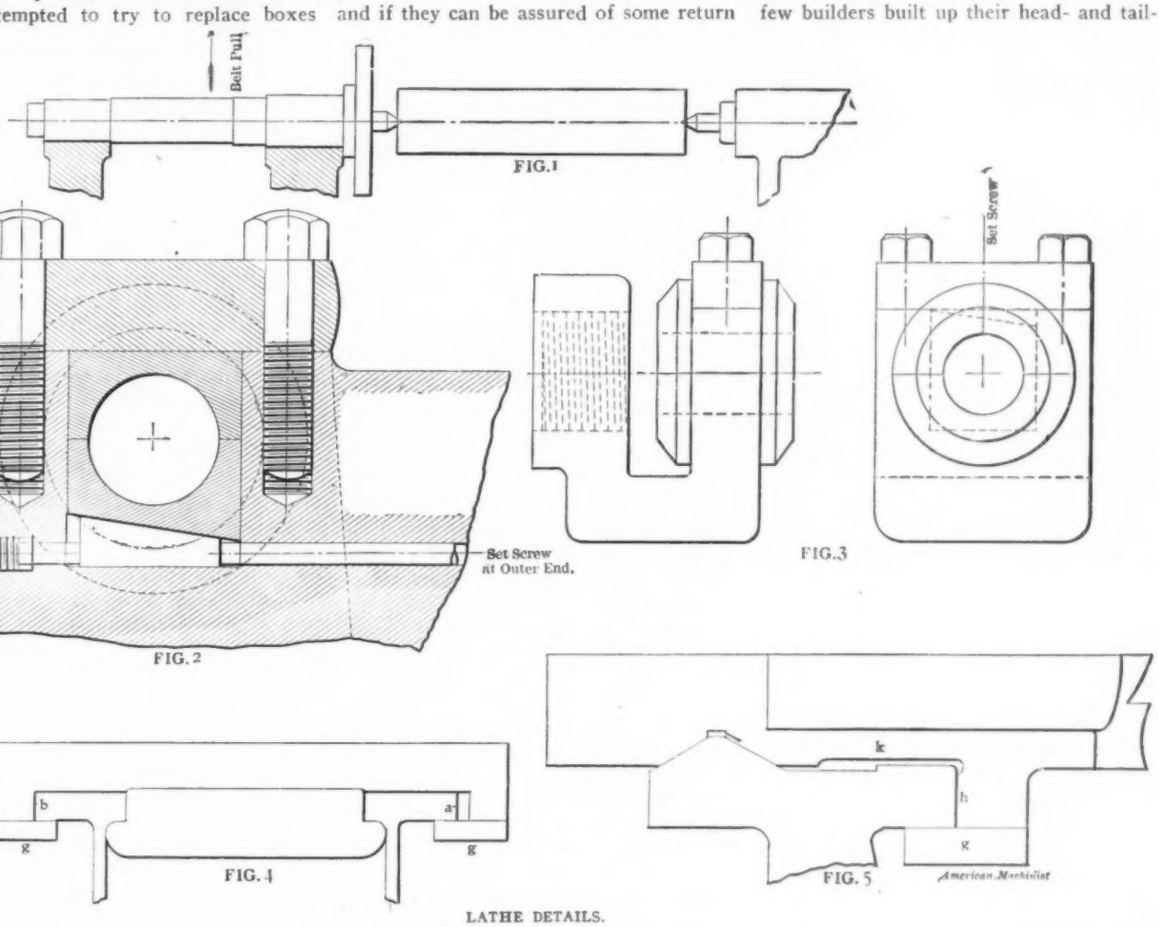


FIG. 1 FIG. 2 FIG. 3 FIG. 4 FIG. 5

LATHE DETAILS.

As far back as 1882, the AMERICAN MACHINIST published an article by Mr. Oberlin Smith on proportions of lathe spindles which I have read many times since and which is worth re-reading by anyone interested in machine design. In this article he advocated the use of spindles whose front bearings were from one-fourth to one-half the swing of the lathe, and predicted that in a score of years such spindles would be in common use. While his prediction has not come true, the tendency that way is unmistakable, and another ten years may quite possibly see it realized. The only rational reason why such proportions have not already been reached lies in the fact that the average purchaser of a lathe expects to use it on all sizes of work within its range. If he wants to cut a quarter-inch screw on a 36-inch lathe, he expects speed enough to do it. Worse than this, he expects to do filing and polishing in the same lathe. So long as these conditions remain we have to make spindles small enough so that they can readily be run fast. As such conditions are gradually going to the rear, there is hope for a rationally designed lathe spindle.

Of course the first cost of a lathe with such a spindle will be considerable, but purchasers to-day are looking for results, and if they can be assured of some return from an investment they will go down deep into their pockets. More than that, they are ready to furnish the necessary power to drive the lathe, although that and the means of transmitting variable motion to the spindle are not a part of the present article.

The position of back gearing, length of spindle (within reasonable limits), means for taking end thrust, etc., do not have a great effect on the subject under consideration compared with the form and shape of the bearings, and more especially the method of supporting cutting tool and work.

THE CARRIAGE.

We will consider them in order. First, holding the cutting tool. We are so accustomed to the dovetail cross-slide, swiveling compound rest and another dovetail slide on top of that that we seldom stop to think of their qualifications. In fact, they work well on work of small diameter where the cutting tool can be held centrally over the cross-slide. On small lathes the design of the compound rest is usually better than on large ones. This is the result of the way they have been evolved. Fifteen years ago a 12- or 14-inch engine lathe with a compound rest was a novelty in this country. The cross-slides were made of a comfortable width and of course could not be made very high. Then the demand for a tool for foreign trade led to the designing of compound rests. A few builders built up their head- and tail-stocks an inch to get more room, thus making a 12-inch lathe into one which the dealers sold as a 14-inch or even a 16-inch machine, and were enabled to make what they called a substantial compound rest. The others, finding themselves limited to a very small height, gained strength by spreading out horizontally, with the result that many of these little rests are very small and light, although the proportions are good. The designers of large lathes, on the other hand, have built up structures like the conning tower of a battleship, but so long as the cutting tool is over this cob-house and there is not a great lateral pressure it answers quite well.

It seems necessary to have at least five

surfaces of contact between the bed and the tool. First, the slide of the carriage on the bed, which must be free to move when taking longitudinal cuts; second, the cross-slide in the carriage, which may be clamped during longitudinal cuts; third, the swivel joint for the compound rest, which is usually a flat-scraped and bolted joint; fourth, the compound-rest slide, which is usually locked when either of the other feeds are in use, and, fifth, the tool-post, which last is a relic of Yankee toolmaking and is the ancestor of fiddling cuts and hairbreadth feeds.

Of the above it is sometimes attempted to transfer one or more to some other parts of the lathe; as, for instance, Prof. Sweet's swiveling-head lathe, and later the Jones & Lamson sliding-head lathe. By the way, remembering the storm which Prof. Sweet's lathe brought out and the number of men who "proved" that it was impossible to re-aline it, it seems strange that no criticism has apparently been raised of the Jones & Lamson lathe. Possibly we are getting where we believe everything possible.

THE CARRIAGE WAYS.

But to get back to our lathe. Let us consider each of these surfaces of contact in order, beginning with the carriage ways. The English form of bed with flat ways locked by either square or bevel gibs has some good features which we Yankees are apt to overlook in making comparisons, but which we are bound to recognize soon in view of the much more rapid progress which they are making in the use of high-speed steel than we are.

Fig. 4 shows a cross-section of one form. In this the principal wearing surface is horizontal, and if clean and well lubricated will surely give long life with little wear, as it squarely resists the principal component of the forces acting on the tool and also carries the weight of the rest, which is no mean mattter with a lathe designed to carry work up to the limit of tool capacity. The forces acting on the tool also bring wear on the back vertical side of the bed at *a*. This surface is also well adapted to take the wear, and if the packing at *a* is a solid packing, it seems to fill all possible demands. By a solid packing, I mean one like a taper packing, which comes metal to metal and does not press simply on the points of set-screws. The vertical surface at *b* receives little or no wear, so it is always possible to preserve the fit of the carriage to the bed sideways by scraping the back edge of the bed till the carriage runs freely, without losing the straightness of the bed. I consider the gibs to hold the carriage down of little value, except as clamps to hold the rest during facing cuts. The condition that we made above, that the ways must be kept clean and well lubricated, proves to be the drawback to this form, especially with workmen used to the V-beds. The back way is not apt to be bothersome, for chips do not pile up there much, nor do men use it for an anvil or even to lay tools on a great deal. The front way is nothing but a tool shelf and soon becomes pockmarked. Every depression is surrounded by a raised ring, which does its best to wear a groove in the carriage. Moreover, the oil stands on these flat ways so long that it gums up overnight. The workman never thinks of wiping off this gummed oil before oiling up again, and we soon have a rubbery, sticky surface that acts with the aid of gray-iron dust as a lap to wear out the carriage. If all lathes were for short work, it might be possible to provide guards to keep the dirt off, but as these would only cover up the accumulation of oil and dirt, they would not be so very great an advantage, after all.

Now, suppose we could get someone to build a lathe with a front way shaped like Fig. 5, with a broad, flat V, having an angle of, say, 120 degrees. Tools laid across this V do not touch the bearing surface any more than in the steep angle V's now in use. The top is rounded a trifle, so that a bur is not likely to be raised at the edges. Oil will run down slowly and off, perhaps wasting more oil than is really necessary; but oil costs less than lathes, or more skilled or more careful workmen. I would also suggest the desirability of fitting the carriage and bed as shown at *h*, Fig. 5, to avoid a lifting tendency on heavy cuts. It will be seen that this vertical face effectually prevents the carriage lifting in any but a vertical direction, which the forces acting on it prevent. There would not be any object in making face *h* adjustable, except for convenience in construction, as three faces, disposed as shown, will wear together.

I consider the gib at *g* as of no value, except for locking the carriage to the bed under facing cuts, for which purpose it is in just the right place, especially if (on large lathes, especially) there is provided a bearing on the flat way at *k*. A gibbed rest is necessary for boring work fastened to the rest with a boring bar between centers, as in using a boring tool in the tool-post reaching out beyond the wings of the carriage, but I have no patience with either of these ways of doing work since the advent of boring machines. A purchaser has no right to expect a single lathe to do everything that comes into his shop. The back way can be flat as well as not; in fact, a good deal better than not. For the reasons for this, see Professor Sweet's numerous articles. The only valid objection to the use of a V for a guiding bearing at the front and a flat way at the back is that customers object. The reason why they object, I strongly suspect, is because they are approached on the subject in an apologetic manner. It has been my experience that customers usually take whatever is offered them by a man who has perfect confidence in what he is selling. In fact, the writer feels that buyers are really too ready to encourage manufacturers to build something new and to try experiments on them and really at their expense.

Covering a Long Drawing Board With the Universal Drafting Machine—Care of the Health—Writing Dimensions.

BY E. R. PLAISTED.

While not all draftsmen who read the AMERICAN MACHINIST are provided with the Universal drafting machine, I believe there are enough of them using it to make the following of general interest. When we bought the drafting machine, we selected the smallest size, listed to cover a board 18x24 inches, as most of our drawings are of this size, and I thought the larger machines would prove heavy and cumbersome for our small work. I have had no reason to regret my choice of the small size, but as we do sometimes have to make drawings five feet long, I have been casting about for means to make the little machine cover a board of this length with convenience and precision.

The makers provide special adjustable anchor plates which can be attached to large boards in pairs, lined up together, and then the machine can be lifted from one to the other without disturbing the alinement; but I found these devices rather inconvenient, for it not infrequently happens that one wants to work over the board at once instead of completing one-half of the drawing and then beginning work on the remainder.

After chewing over the matter for some time, I concluded that a gibbed slide, arranged at the back side of the board, to which the ordinary non-adjusting anchor plate could be attached, would allow the entire machine to slide freely from one end of a long board to the other. As two jobs calling for long drawings happened to come in at once, I had a rather crude wooden model of the device made immediately; but, crude as it was, it gave most gratifying results, and I send a sketch of it, as well as of the more finished arrangement I am now having made to replace it.

Fig. 1 shows the first arrangement so completely that a description seems almost unnecessary. The slide is about 18 inches long, 3 inches wide and ¾ of an inch thick, with the anchor plate attached to the extreme left-hand end. The gibbed bar which carries it is about a foot longer than the board, the excess of length projecting at the left and thus allowing the machine to work close up to this edge of the board. It was made with the back gib adjustable to allow for atmospheric changes and for wear; but I soon found this was not needed, as the overhanging weight of the machine causes a cramping of the slide, and even if this is quite a

loose fit when the machine is lifted for shifting, it comes to a snug bearing when the machine is again dropped upon the paper.

Its accuracy is all that one could reasonably ask for, the error being less than that in the paper due to weather changes, and less than that in any five-foot T-square I ever used. In the matters of speed and convenience, the gain over the T-square is much greater in the case of a long drawing than with a small one, for one can handle a small square to better advantage than a long one, and a slight error in the edge of the board does not become so magnified. With this arrangement there is practically no limit to the length of drawing one can cover with the drafting machine, though the width is limited to about 30 inches with the smaller size.

Not wishing to disfigure my large drawing table with the wooden arrangement, the top being a 36x60-inch K. & E. drawing board, I devised the light metal slide shown in Fig. 2. The grooved guide is planed from angle iron and the slide is of cast brass, no provision being made for adjustment for wear, on account of the binding action before noted. It is not yet completed, and while it should prove more accurate than the wooden one, the latter is plenty good enough in this respect. A portion of the anchor plate is ground off to make it of the same width as the top of the brass slide, and one of the screw-holes is slightly slotted to allow the plate to be lined up with the front edge of the board. All that is visible at the back edge of the board is 3/8 of an inch of metal.

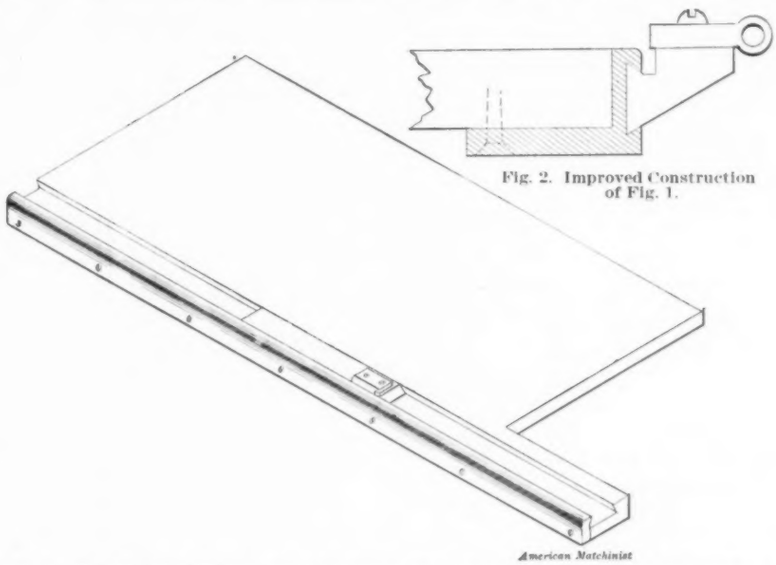


FIG. I. DEVICE FOR COVERING LONG DRAWING BOARD WITH THE UNIVERSAL DRAFTING MACHINE.

I believe the ordinary Universal drafting machine, arranged in this manner, is preferable to the new model recently brought out, especially designed for use on vertical boards and large drawings, as this new machine can only cover drawings of great vertical dimensions, the horizontal width being limited by the length of the straight-edge. In making anything like the floor plans of a long shop or factory, I should imagine a vertical arrangement would be decidedly inconvenient, as most drawings of this sort are made to read from the side and not from the end. In the case of a tall chimney or a section of a mine shaft, the vertical drawing would doubtless be preferable.

Of course, it is desirable to be able to use the board inclined at a considerable angle, even when the vertical dimension of the drawing does not exceed 30 inches, and I find the machine works well without counterweights or springs for slight angles; but above 15 or 20 degrees some sort of counterbalance device is necessary. A spring can be placed in the ring joining the arms of the machine, but one strong enough for 55 degrees is quite too stiff for 30 degrees. I had the back gib rounded at the top corner, and over this rounded corner I pass a cord attached to the main head of the machine and carrying a suitable weight on the other end. I am by no means satisfied with this arrangement, but it is the best I have been able to devise up to date.

Fig. 2. Improved Construction of Fig. 1.

CARE OF THE HEALTH.

Mr. Pearce's little story of a success (?) at page 228 is nothing less than a tragedy, and a most pathetic one at that. No amount of money or advancement can possibly compensate a man for the loss of good physical health, without which nothing in life can be fully and completely enjoyed. It is bad enough when one brings up in a sanitarium or an asylum as the result of too much whiskey and cigarettes, and perhaps more discreditable than when it results from excessive study, but either means irreparable damage and ruin to the individual, while the world loses a helper and gains one more burden; and in the latter case one hasn't even the excuse of a bad example or inherited propensities.

It is all very laudable for a young fellow to be ambitious and to wish to climb to the very topmost notch of his calling, but when health is sacrificed in the scramble one would much better have been content to stop on a lower plane than go beyond one's strength. A man's health should be of more importance to him than almost anything else, and most of us find a reasonable amount of wholesome sport and exercise needed to keep us in good physical condition. As I have before made quite a few remarks on healthful exercise for draftsmen, I will not now enlarge on the matter, for the AMERICAN MACHINIST is not a "health culture magazine," further than to repeat that we generally get the best of light and air, and if we become round-shouldered and dyspeptic it is usually from lack of correctives within the reach of everyone.

Furthermore, and speaking from the employer's point of view, any workman can accomplish more in ten minutes' clear-headed thinking than in half an hour's cudgeling of a brain poorly nourished through sluggish circulation of the blood. Therefore, when one has been bent over the board for a long time, a few minutes spent in dumbbell or other exercises of that sort is time spent to the best possible advantage of the employer as well as the employee. For this reason I consider my dumbbells one of the best time-saving devices in my drafting-room.

WRITING DIMENSIONS.

Now that Mr. Bell has called our attention to it, on page 225, it surely seems absurd for a draftsman to write 2′—5″ when he means 2′+5″, but I'm thinking there would be a howl from the shop if we were to dimension our drawings in this way. It isn't always easy to make people accept things which are really much better than those they have grown accustomed to through long usage; in fact, long-established custom is one of the most discouraging things to buck against.

In the matter of writing dates, I believe it is usual to place the day before the month in nearly all foreign countries, which is certainly consistent, for they are all units of time and should be arranged in order of their magnitude, the same as feet, inches and fractions of inches. Just why we sandwich the day in between the month and year is a puzzle, and it is also puzzling to tell which is best, to put the largest unit first, as we write linear measurements, or last, as in the case of writing dates. When we are limited to a single point of view it is not always easy to say whether the horse is before the cart or the cart before the horse. It may be best, on the whole, to do as Romans do when one is in Rome, but Rome met her downfall at last and very posibly because she "got a bump on herself" and didn't keep up with the times.

[We have always looked upon the mark placed between the feet and inches of a dimension as a dash or separating mark, and not as a sign of addition. It is often omitted, and we think the idea behind its use is to prevent possibility of confounding the feet and inches. 2′ 3″ may, if the foot mark be indistinct, be read as 23″, whereas when written 2′—3″ this becomes impossible.—ED.]

The Cutting Capacity of Power Presses.

BY E. W. ZEH.

Power presses, when used for cutting purposes, such as blanking, etc., have to work under such varing conditions, especially as to the thickness and kind of material, that it seems at first sight almost impossible to give definite rules for the cutting length that can be obtained. In investigating this subject, we find, however, that there are some principles which, when understood, will give a clear idea of the conditions and enable us to frame some rules and formulas which are of great aid in determining the cutting capacities of power presses. It appears that these principles have heretofore not been generally understood.

In order to develop and prove these rules, we have to pass through some theoretical considerations; but the results are of a plain, practical nature. The cutting capacity of a given power press is fixed by that part of the energy of the flywheel ($.5\ m\ v^2$) which is available, and which is determined by the dimensions of the flywheel and its speed. In this article we will treat plain power presses only, that is, presses which are driven direct by the flywheel without the aid of gearing.

In most cases a certain cutting length of a power press for a given thickness and kind of material will be known, either from the meager information which some press manufacturers give, or through experiments, and the question arises: How does the cutting length increase or decrease when the thickness of the material varies? It is evident that there must be a law which governs this, and it may be said that *the cutting length of a power press increases inversely with the square of the thickness of material.* In plain words, this says that if a power press cuts a certain length of a given thickness of material, it will cut four times this length of the same material of one-half the original thickness.

If we assume parallel cutting edges, we find that the power (expressed in inch-pounds) necessary to shear a flat bar is

$$A = t\,l\,s\,t \text{ or } A = t^2\,l\,s. \qquad (1)$$

in which

t = thickness of the material.
l = width of the material or cutting length.
s = ultimate resistence to shearing.

The cutting length is, therefore:

$$l = \frac{A}{t^2\,s} \qquad (2)$$

This equation says that the cutting length is directly proportional to the power of the flywheel, and inversely proportional to the square of the thickness and the resistence to shearing.

The fact that the material is severed before the upper knife has descended the full thickness of the bar brings in another influence which has to be taken into account. This depth of penetration, as we will call it, varies greatly. It is influenced by the ductility and thickness of the material. It increases as the thickness decreases, but not in simple proportion. The table gives the results of some experiments with soft steel, which, however, were not very extensive, most of the values being interpolated; t stands again for the thickness of the material, and p for the depth of penetration.

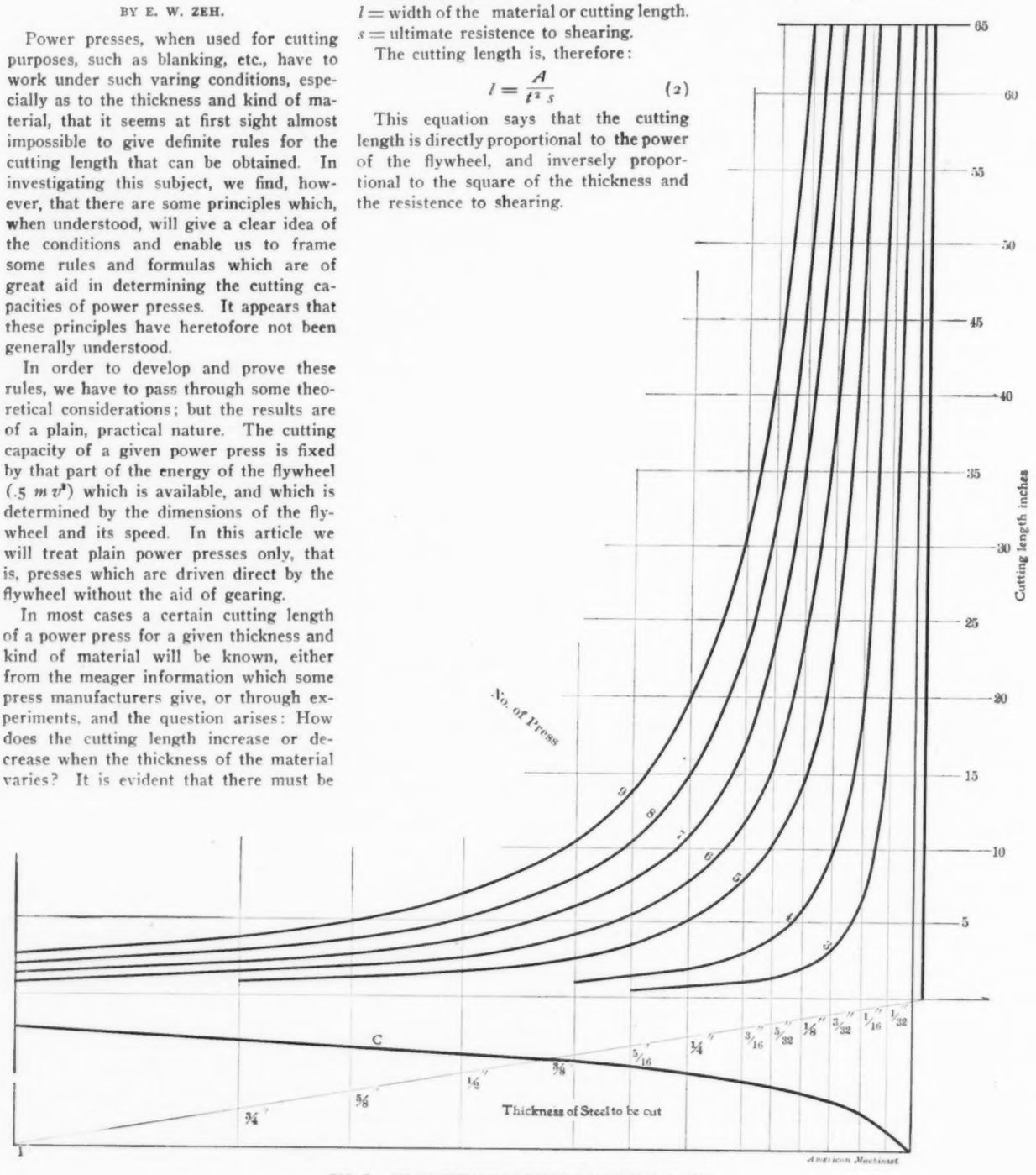


FIG. 1. CHARACTERISTIC CURVES OF POWER PRESSES.

t =	1	¾	⅝	½	⅜	$\frac{5}{16}$
p =	.25	.31	.34	.37	.44	.47
t =	¼	$\frac{3}{16}$	⅛	$\frac{3}{32}$	$\frac{1}{16}$	$\frac{1}{32}$
p =	.5	.56	.62	.67	.75	.87

VALUES OF THE DEPTH OF PENETRATION.

In Fig. 1 the curve C shows in a graphical manner how the depth of penetration varies. It would be an interesting problem to ascertain the true nature of this curve of penetration for various materials. It could be done very readily by means of an hydraulic bolster and steam indicator.

Taking into consideration the depth of penetration, our formula for the cutting length will now have the following form:

$$l = \frac{A}{t^2\, t\, p} \qquad (3)$$

When the cutting length of a power press for a certain thickness t and resistance s is given, and it is desired to know the cutting length l_1 for another thickness

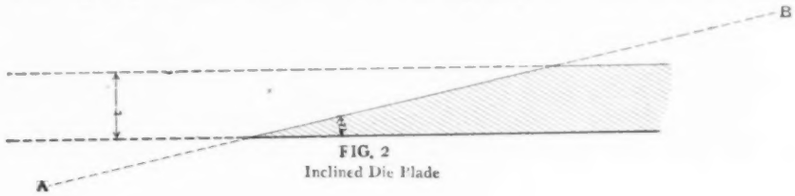


FIG. 2
Inclined Die Blade

FIG. 3
DIE BLADE WITH MULTIPLE POINTS.

t_1 of the resistance s_1 the following formula, which is derived from (3), will give the answer:

$$l_1 = \frac{t^2\, l\, p\, s}{t_1^2\, p_1 s_1} \qquad (4)$$

in which p_1 stands for the depth of penetration for the new thickness introduced.

While the above formulas enable us to ascertain the cutting length which we can obtain in a given power press, another factor has also to be taken into consideration. The pressure required to force the knife or die through the material must not exceed a certain maximum which is fixed for each press. To keep the pressure within this limit, it is often necessary to incline the edge of one of the dies. In order to come to some conclusions about the degree of this tip or the cutting angle, we will have to dwell somewhat on the shearing problem.

When the cutting edge AB, Fig. 2, descends, it finds a resistance

$$P = .5\, t^2 \text{ cot. } \alpha\, s, \qquad (5)$$

in which

t = thickness of the material.

s = ultimate resistance to shearing.

α = angle of the knife.

This formula is limited in one direction to which attention should be called, viz., the width of the bar divided by its thickness must be greater than cot. α.

To find the angle which the upper knife must have to keep the maximum pressure within the limit of the press, formula (5) may be inverted thus:

$$\text{cot } \alpha = \frac{P}{.5\, t^2\, s} \qquad (6)$$

When closed cutting dies are used, for instance, a round blanking die, it is customary for practical reasons to give the die (or punch) several high points, and now the question arises: How does the number of cutting points affect the pressure which is required to penetrate the material?

In answer to this question we may refer to Fig. 3, in which c is the developed circumeference or cutting length of a round die. According to formula (5) the pressure necessary for one inclined side of the punch is equal to .5 t^2 cot. α s, consequently for both sides of one cutting point the pressure is twice this amount or t^2 cot. α s. If n be the number of cutting points, the total pressure necessary is

$$P = t^2 \text{ cot. } \alpha\, s\, n. \qquad (7)$$

$$\text{cot } \alpha = \frac{d}{b} \text{ and } d = \frac{c}{2\, n}$$

consequently

$$\alpha = \frac{c}{2\, n} \div b$$

This value, substituted in the formula (7), gives:

$$P = \frac{t^2\, c\, s}{2\, b} \qquad (8)$$

In this formula the number of high points does not appear at all, showing that the pressure is not influenced by the number of such points and merely depends upon the amount of shearing b. To ascertain the amount of shearing b which we must give a die to keep the pressure within the limit P, we give formula (9):

$$b = \frac{t^2\, c\, s}{2\, P} \qquad (9)$$

While we started from a plain round cutting die, these formulas will hold good for irregular dies. In this case it is only necessary to observe that all sections of the cutting edge have the same inclination.

The cutting capacity of a given power press for a certain thickness of a certain material being known, it is possible to draw a characteristic curve which shows the cutting lengths for any other thickness of the same material. Such curves have been drawn in Fig. 1 for sizes Nos. 3 to 9 of the Zeh & Hahnmann power presses. They are based upon steel of an ultimate strength of 60,000 pounds per square inch. The diagram is self-explanatory.

These presses are graded in such a manner that they exert a maximum pressure in tons equal to the square of their number. The No. 5 press, for instance, exerts a maximum pressure of 5×5 or 25 tons; the No. 6 of 6×6, or 36 tons, etc. These pressures must be known to a diemaker in order to enable him to determine the proper amount of shear by the formulas given to obtain a safe result.

Following are two practical applications of the formulas:

(1) A die has a cutting length of 14 inches in ⅛-inch soft steel. Which size press is required?

Our diagram shows that the No. 5 press cuts ⅛-inch steel about 14 inches long. Consequently this press will do the work. This press, exerting a maximum pressure of 25 tons, we have to shear the die sufficiently to keep the pressure within this limit. According to formula (9) this shear must be at least

$$\frac{1 \times 14 \times 60{,}000}{64 \times 2 \times 50{,}000} = .14 \text{ inch.}$$

This being the extreme limit, it would be well to increase the shear somewhat, say to .2 or .25 inch.

(2) If a power press is given, of which we know that it cuts ⅛-inch soft steel 14 inches long, and it is desired to know the cutting length for 1-16-inch material, we will find it by means of formula (4):

$$\frac{14 \times .125^2 \times .62}{.0625^2 \times .75} = 44 \text{ inches.}$$

.62 and .75 are the respective depths of penetration; s is without influence, as the material is the same in both cases.

The water-power development at the Willimantic mills of the American Thread Company is remarkable for the fact that the intakes to the wheels are from three different dams about 500 feet apart. The canal from the first dam feeds an 800-horse-power horizontal turbine, which discharges its water into the pond of the second dam. This pond feeds three 250 horse-power vertical turbines, which discharge into the pond of the third dam. This pond furnishes water to two 75 horse-power vertical turbines. The average total available water power is 1,100 horsepower, a little more than a third of that required to run the mills.—*Engineering Record.*

A fine of $250 is imposed in Germany for marking objects or packages with any sign calculated to impress one with the idea that they are patented when they are not.

A Cost-of-Production Chart for the Superintendent.

BY GEO. P. PEARCE.

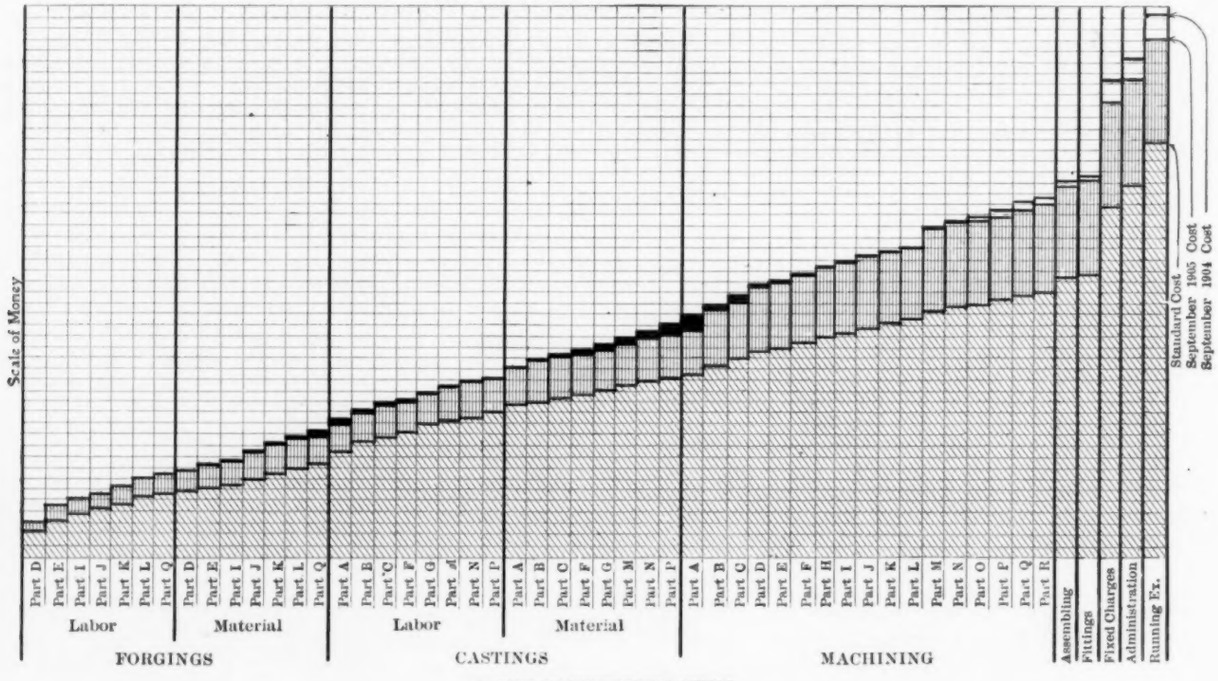
In spite of the thousand and one details which are supposed to reduce the cost of production to a minimum and keep it reduced, there is a considerable fluctuation in the actual cost constantly taking place, and it is most important for the superintendent to know the extent and location of these fluctuations and at least once a month compare them with the standard cost and the cost for the same month the previous year.

The standard cost means what the cost of production would be if every man, department and machine were working at their full capacity, and is calculated by assuming that each article costs exactly what the total of its piece-work prices, raw material, fixed charges and department expenses amount to. This cost is used by many firms under the impression that it represents their actual producing cost. This fallacy can soon be exposed by a little investigation. For instance, suppose a batch of 100 machines is to be made and in the foundry it was necessary to cast 110 sets before 100 sets of good castings were obtained. It is obvious that the 10 extra sets increase the cost of the 100 sound sets by about 6 per cent. In the machine shop a partly finished casting occasionally gets broken or spoilt, and this will also increase the actual cost of the finished batch. These contingencies frequently increase the cost as much as 25 per cent. above the calculated cost; in one instance I know of it reached 40 per cent.

Thus it is of great importance that the superintendent should know the exact fluctuation month by month, and so know where extra supervision is necessary.

There are many methods of obtaining the data of these variations. Probably the best one is that which considers each department or sub-department as a separate concern and charges it with all material received and credits it with all material delivered to the next department. This system will instantly show up any loss or waste, but it requires very careful watching and must be enforced to the limit, because it can be very easily put out of effectiveness by slight errors, or by allowing material to be moved without an order.

When the cost keeper gets these figures, instead of making out a big list of figures showing the different costs, losses and gains for the different departments and presenting the whole mass of figures in this state to the superintendent, thus taking up a considerable amount of his time in studying up comparative gains and losses, he gives all his figures to the draftsman, who takes a sheet of drawing-paper of suitable size and makes out a chart like the one shown in the illustration. The vertical lines are to a scale of dollars, or cents, as the case may be, and the spaces between the vertical lines represent the different parts of the machine under analysis, such things as bolts, studs, washers, etc., being classed together as one piece. Next he fills in the standard cost curve from the piece-work cards and raw-materials costs, shading or gray-tinting the enclosed space so that it is conspicuous. Then the curve from last year's sheet of the similar month is copied and any bad management or wrong methods of operation are instantly picked out.



A COST-OF-PRODUCTION SHEET.

At the end of the year the 12 charts are taken, and from them a new one is made showing only the standard cost and the average of the 12 monthly curves. This is kept by the superintendent. Of course it is necessary to make a chart for each of the firm's chief specialties. No chart need be made for small side work, unless particularly wanted.

The breaking of an air-brake attachment recently in the Pennsylvania shops at Cleveland nearly killed James Coughlin, who, as car repairer, was testing a brake attachment, when the joint broke and he was struck in the forehead by the metal-tipped hose connection and knocked unconscious. He was taken to the Cleveland General Hospital in a serious condition, his skull being fractured.

The Gisholt Machine Company's New Foundry.

The accompanying illustrations show exterior and interior views of the new foundry of the Gisholt Machine Company The building is of 120x240 feet in plan, is of brick and steel construction, with tile roof; in fact, with the exception of the window frames and sash, no wood whatever has been used in its construction.

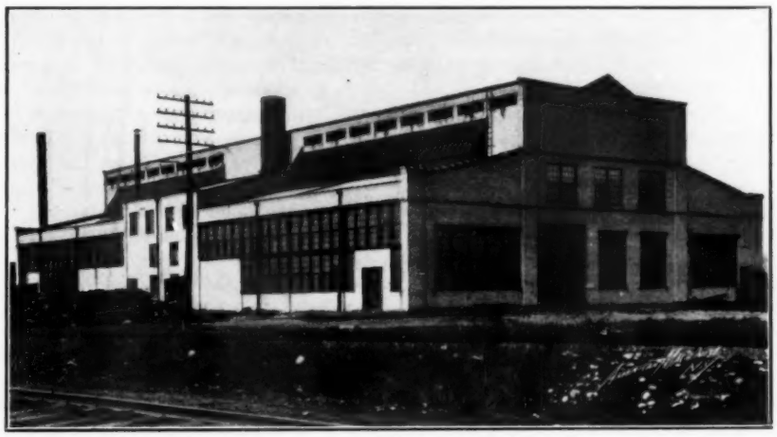


FIG. 1. EXTERIOR VIEW OF THE GISHOLT FOUNDRY.

For the present, a single cupola, with a capacity of 20 tons per hour, is in daily use, though provision has been made for the installation of another cupola when required. The equipment also includes a 20-ton electric traveling crane, electric hoists, electric sand shakers, special iron flasks, core-making machines, molding machines, industrial railway and large core ovens.

The tumbling and cleaning rooms are in a separate building, the tumbling barrels being electrically driven. The casting storage building, of 100x200 feet, is connected with the foundry by an industrial railway system, and is fully equipped with traveling crane and hoist. The pattern shop, of 125x210 feet, is also conveniently situated.

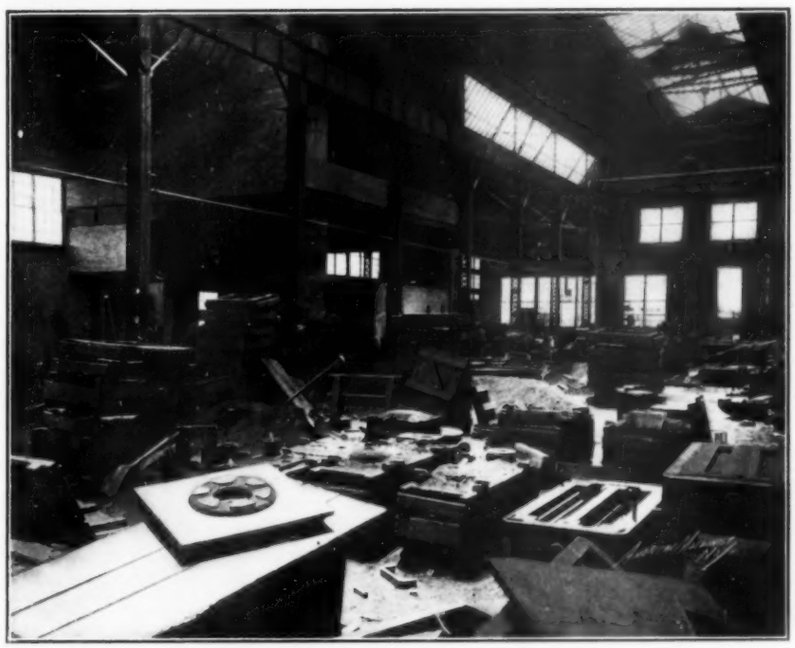


FIG. 2. INTERIOR VIEW OF THE GISHOLT FOUNDRY.

Oil Fuel for the British Navy.

In connection with the decision of the Admiralty to utilize the extensive wharves at Plymouth for the construction of a large oil-fuel depot, this is the outcome of a long and rather costly series of experiments with oil fuel. Those experiments have been so far satisfactory that very extensive alterations to permit of the use of this fuel were made in the boiler furnaces of the battleship "King Edward VII," which, when completed, was regarded as the most perfect warship afloat. Other vessels have been similarly fitted, among the number being the battleship "New Zealand" and the cruiser "Carnarvon," and it is now intended that much smaller ships shall be adapted for the use of oil fuel. Warships so fitted have hitherto received their supplies from steamers like the "Petroleum," "Khaki" and "Scourge," but as the use of oil fuel is becoming more general, it has been found necessary to establish storage depots in the principal home ports. Thus it comes about that the Plymouth wharves are to be used for this purpose. For the past fortnight architects and surveyors have been preparing plans for new works there, and orders have been given that the coal which has been stored on the property for some time past is to be removed without delay. Only three weeks ago something like 8,000 tons were stored on the Government property at Plymouth. Most of this stock has already been removed.—*Colliery Guardian.*

The following is from the editorial columns of the *American Engineer and Railroad Journal:*

Railroad repair shops probably use more machine tools than any other one metal-working industry in this country, and yet we find that only a few of the machine-tool builders have devoted any special study to this field. Those who have done so have found the railroads ready to co-operate with them in their efforts to improve or adapt their tools to the work. The larger number of machine-tool builders, although they have sold many tools to the railroads, have never made any special effort to follow them up and see what class of work they were doing or to find out what satisfaction they were giving. Some of them have sold their tools to the railroads through agents, and cannot even tell at what shops they were installed. The purpose of this editorial is not to give the impression that the machine tools used in a railroad repair shop should deviate greatly from the standard machines, but rather that often a few slight changes from the standard or the addition of special attachments will greatly improve the output of the machine for special work, and will afford much more satisfaction to the user. A system for following up the tools could be installed and conducted without any great amount of expense, and would certainly repay for itself many times over if intelligently handled. A case was recently called to our attention where a machine-tool builder had occasion to visit a certain railroad shop, and after examining some of the work which was being handled on one of his standard machines, was enabled to make certain changes on a new machine which he was about to install which made it possible to practically double its capacity over the standard machines for this class of work.

Letters to the Editor.

Selecting Belts—Leather and Stitched Cotton.

The problem of getting the best belt service for the least money confronts the designing engineer every time he lays out a factory transmission. The solution of the problem is much like that given the citizen who complained to the alderman that the sewer overflowed into the cellar and drowned the citizen's hens. The answer was, "Kape ducks." The answer to our belt problem might well be, "Use ropes!"

But belts will be used, no matter if the rope drive figures the most convenient, and the engineer must continue to lay out belt transmissions and to specify the kind of belts to be used. If he specifies, "72 feet of 12-inch double-leather belt" the belt men don't do a thing to that engineer when they get hold of him. Five belt salesmen will call at once and two succeed in getting at him, while two more cut off escape in front and the other belt man guards the rear.

Every man-jack of those belt men has the very best belt in the market, and will sell it at the best price. One chap has "short lap" all back stock, which he offers at 60 per cent. off list price, and the next chap has a short lap "back cut" belt which is warranted to weigh more per square foot and to last longer and pull more than any other belt, etc. The man who is waiting evidently has a belt better than both those of the other men put together.

Taking all the above into consideration, what is the engineer to do for his own protection? How can he compare one belt with another? How can he determine the comparative worth of the "short lap" light-weight belting, the "strictly short-lap belting," in accordance with "United States specifications," and compare Leatherboy's "Chestnut" belting and Stanley's "Pullhard" brand?

In self-defense, after purchasing belt from many concerns, I hit upon the following method of comparison which led right straight to "easy street" without a turn. It took all the wind out of the belt man's sails and made belt buying an exact science instead of a full-fledged lottery transaction.

The draftsman made a tracing of the blank shown herewith and a lot of blueprints were made, one of which was given to each belt man who called, with instructions to fill out the discount blanks, and that purchasing would be done only in accordance with the figures there tabulated.

Considerable kicking was done by some of the belt men, who stated that their respective houses did not care to state the exact lengths and weights of their belting. This argument was met by the statement that no belting would be purchased, except from data as per the slips in question, and, finally, every belt concern handed in a filled-out slip. Most of the slips bore only one or two discounts, notably that in the space controlled by 16 ounce and 4′-6″, which is the standard belt. In almost every instance the discount was 60 per cent. off list, showing that the same belt will cost the same, no matter from whom it is purchased.

No attention whatever was paid in purchasing to the weight or to the thickness of the belt, for it is very easy to "stuff" a belt so as to increase the thickness, also the weight to a considerable degree, therefore this matter was left almost entirely out of consideration. Almost any hide will make a lap 4′-6″ long, and the strength does not depend entirely upon the thickness of a hide by any means.

There is a considerable difference in the manner of putting up belting, by different concerns, which the would-be purchaser should acquaint himself with, otherwise the purchase may be safely made from the "Discount Specification Sheets" filled by the belt men. Only one concern, in a fierce competition, had the honesty to boldly fill the 8′-0″ blank, and they put in "60-10 and 5 per cent." And this belt was specified by me for several years with satisfaction to all concerned.

Weight per Square Foot.	Total Length of any Lap not to exceed the following:							
	4′-0″	4′-6″	5′-0″	5′-6″	6′-0″	6′-6″	7′-0″	8′-0″
16 Ounces	60%							60-10-5%
11 "								
12 "								
10 "								

The undersigned hereby agrees to furnish Leather Belting for.....

.....from date, of the weights, laps and discounts specified above.

(Signed) .....

New York,.....1905.

American Machinist

DISCOUNT BLANK FOR LEATHER BELTING.

The concern in question took great care in putting together the laps—double belt only was used in the work above referred to—to put the neck end of two laps against the rump ends of two laps. In other words, the laps were joined together "neck and neck" and "rump and rump," then the two strips were pulled along and matched up so that a neck strip was fastened to a strong rump strip through the entire length of the belting. Single belts are not considered in the above. They are not of much use in heavy work, and where the power to be transmitted is so slight that a single belt will do the work, almost anything will answer the purpose—still, if a strictly first-class single belt is required, it must be made of 16-ounce laps not over 4′-6″ long and center-back at that. But very little single belting can be proven to be center-back.

In seeking to obtain a basis of comparison for the so-called "Gandy" belt, an entirely different method must be followed. This belt has proven a most excellent power transmitter and can be safely specified for almost any service in an ordinary factory. Although originally made by Mr. Gandy, the name is of no more use in selecting belting of this class, which had better be specified as "Impregnated, Stitched Cotton Belting."

When the cotton-belt man comes into the office, take his samples and proceed to "do him up" as follows:

Note if the belt appears to be painted with a substance resembling linseed, or some other of the drying oils, or if it is filled with something which appears like mineral oil and suggests that the threads are stuffed with a paraffin preparation. I prefer the latter for the following reason: It never sets hard when standing idle, and the fibers appear to slide over each other when in use with less wear than with the apparently "linseed-filled" belt, which becomes stiff and hard when standing, and when softened by use the fibers appear to be without any lubricating filling whatever and slide hard over each other.

Make the belt man state the weight of the yarn from which the warp and filling are made, also the number of "picks" per inch, both in the warp and in the filling. The term "picks" means the threads or loops in either the lengthwise or the crosswise material of the belt. However, these are nearly the same in all belts, and are not as important as the "weave," which in cotton belts should be "equalized." This means that the warp, or lengthwise threads should be made of as many smaller threads as there are in the filling or crosswise threads.

The belt man will specify the weave as being 5/6, 6/6, 6/5, etc., meaning that there are five threads in the warp, and six threads in the filling in the first, or 5/6 weave. The next, or 6/6, has the same number of threads in both warp and filling, while the 6/5 has a larger thread lengthwise and a smaller filling. The 6/6 is known as the "equalized" weave, and is claimed to make the best and most lasting cotton belt, other things being the

same, such as weight of yarn, length of staple (length of the cotton fiber), etc.

While obtaining the above information as regards the weave, by raveling a bit of sample belt, look for some other things as follows: The tightness of the weave, for one thing. Cut into the sample, making two knife cuts in the edge, about a quarter of an inch deep and, as nearly as possible, 3 inches apart. Any other distance will answer, but 3 inches is convenient and most samples will allow this length to be taken. Next, slice lengthwise of the belt, cutting off the ends of the threads so that a piece of one of the warp threads can be pulled out. Pull the piece of thread between the fingers and snub it over a corner until it is straight, all the weave corrugations having been straightened out.

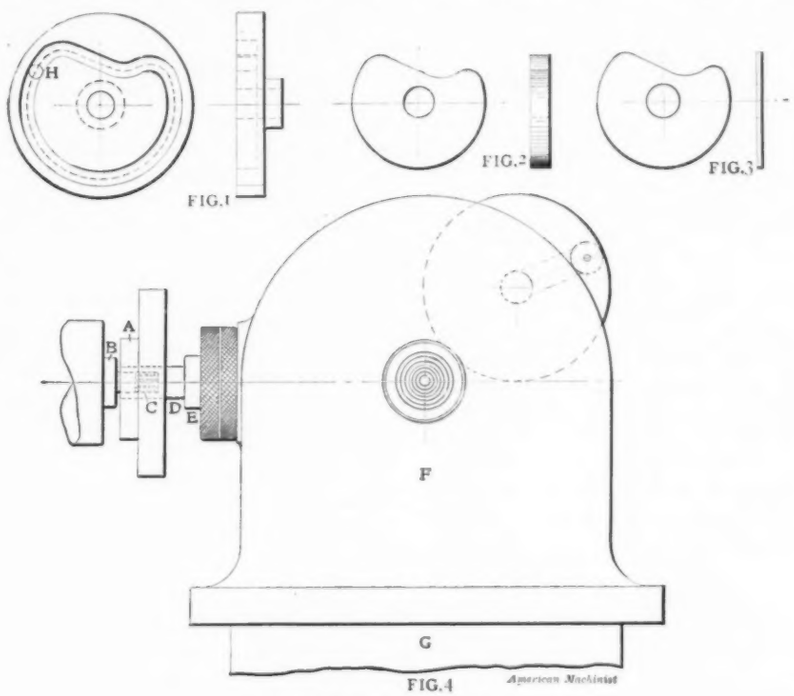
Measure the straightened thread carefully. It may be 3¼ inches long, giving an elongation of 25 per cent. over the length of belt from which the thread was taken. Keep a record of all the cotton belts tested in this manner and you will find that the best belts have about 25 per cent. thread take-up. A belt having more than 25 per cent. will stretch too much and a belt having less thread take-up is too loosely woven to be a lasting proposition, for the looser a belt is woven the less possible stretch the threads have.

After having gone over all the above-mentioned points and tabulated them against the name of the maker of the belt in hand, select to be purchased a belt having about 25 per cent. thread elongation, equalized weave, good staple and a filling not liable to become oxidized and hard from age. It will be found that the prices of this kind of belting, by different makers, are all remarkably close to each other.

JAMES F. HOBART.

Experimental Work—Making a Face Cam.

The term "experimental work," as understood when used in connection with modern factory methods, means the making of models for different purposes. The experimental model is usually made to demonstrate the practicability of one or several devices or principles, and is mainly useful to those skilled in the construction of articles of its kind; the working model is complete in its working parts, and sometimes finished as though it were to be sold, and can be used to demonstrate a device or principle to agents or customers, while a tool or reference model is made to facilitate the making of tools and gages and to test them at times after having been used.



MAKING A FACE CAM.

The experimental model is usually roughly made and pieced together; the working model is finished as well as is considered necessary to insure its withstanding very severe tests, while the tool model is made very accurately to shop standards, as each and every piece is intended to be a standard in every particular for the succeeding processes of manufacture.

In the sketches, Figs. 1, 2 and 3, are, respectively, a face cam, former and try plate, Fig. 4 showing the method of milling the groove in the cam blank.

The plate, Fig. 3, is first laid out and filed to an approximation of its correct shape, allowing a margin for connections and tried in the model in connection with its follower and filed until the proper motion is obtained, after which it is used as a templet for making the former in Fig. 2. After hardening this former it is mounted together with the cam blank on a short drive or screw arbor, as shown at *A*, Fig. 4, where *B* is a collet in the milling-machine spindle, *C* the cutter, *D* an arbor, *E* another collet, *F* the housing of the dividing head, and *G* the milling-machine platen.

It will be understood that the shank of stem cutter *C* is made to bear continually upon the periphery of former *A*, while the cam blank and former are rotated together by the indexing crank of the dividing head, and that radial pressure is maintained by moving the platen to or from the center as required after the cutter has been entered at hole *H*, Fig. 1.

After use, the former plate is stored for reference or for use in making tools or other models.

Sometimes a roughing and finishing cut are taken, in which case the diameter of the cutting portion of the roughing cutter is left small, and both shanks made of the same size.

A. B. CHRISTMAN.

Furnishing Information Regarding Up-to-date Tools.

It usually falls to my lot, when our company wants any tools, to have to look them up and get the lowest prices and all their good points, to be able to tell the powers that be why the one that costs the most is the best, even when, as is often the case, the high-priced one is the lightest; and when they make up their mind that they must have a tool (which, by the way, I may have been trying to convince them of the need of for months), they must have it at once.

A while ago I wrote to a number of manufacturers of lathes, planers and drill presses, asking them to make prompt reply giving all the particulars about changes that had been made to meet the requirements of high-speed steel tools, and I got only one prompt reply, most of them waiting a day or two, and all but one omitting to make any mention of high speed, and a number of them referring us to agents, when in fact they should have answered at once, giving their agents their commission, for ours is a company that will buy at first hand; and one more strange thing about it is, I got replies sooner from Ohio than I did from New York or Massachusetts.

What I claim is, that manufacturers should have up-to-date circulars stating what they would do and had done, and not send the same cuts and circulars that they would have sent five years ago. Most of them in the case referred to did not mention having increased their belt power.

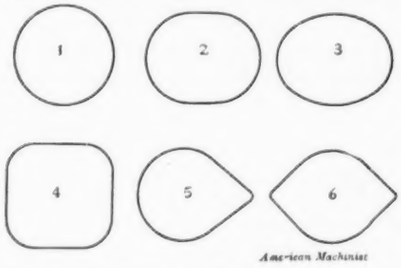
I think that you will get at my meaning, for the order was lost to the company that I think had the best tools, simply because they did not give all details at once.

A. W. P.

Holes in Rail Splice-Plates.

Referring to Shop Notes from Pueblo, Editorial Correspondence, at page 205, an elliptical chuck is thus described: "Figs. 3, 4 and 5 show a thoroughly practical and efficient elliptical chuck which is in constant use for turning punches and dies for the holes in angle plates for railroad rails, which must be oval in shape to permit expansion and contraction."

I have been connected with the manufacture of railway splice-plates for twenty years, and this is the first time that I have



SHAPES OF HOLES IN FISH PLATES.

heard the idea advanced that the shape of the hole in the plate had anything to do with expansion and contraction. This is either a mistake of the correspondent or his informant, because everybody who has any knowledge of fishplates knows that the oval enlargement under the bolt-head is only for the purpose of preventing the bolt from turning while screwing up the nut, and that the bolt is only enough smaller than the hole to allow it to enter easily. Expansion and contraction are provided for by making the holes in the rails much larger than the bolts passing through them, these holes being usually from 3-16 inch to ¼ inch larger than the bolts. The bolt-heads being spherical in shape, it becomes necessary to have an irregular enlargement under the head to correspond with the hole in the plates to prevent turning of the bolt; otherwise round holes would answer as well on both sides. It is the present practice of some engineers to use round holes in the outside plate.

I submit illustrations of the various shaped holes we are making. Nos. 1, 2 and 3 are used in this country; 4, 5 and 6 came to us through foreign orders. The elliptical hole is the one generally used here, and it is the best in every way. There are no sharp corners from which cracks might develop, and the punches and dies are easily and cheaply made, thanks to the elliptical chuck illustrated in the article quoted above, of which we have three in constant use.

In view of the fact that we make nearly one hundred different sections, including tee and street rail fishplates, with a different spacing and elevation of holes in most of them, the man in charge is entitled to more credit than he usually gets for keeping things hustling.

The largest street-rail splice-plate we make contains fourteen holes—twelve bolt holes and two bonding holes—all being punched with one stroke of the machine.

J. J. NEWBAKER.

[The correspondent must own that the expression, "which must be oval in shape to permit expansion and contraction," is his own, and was an inference based on the shape of the holes. However, the object of the article was to show a successful elliptical chuck, and this seems to have been accomplished.—F. A. H.]

Putting a Sea-Cock on a Ship's Bottom.

The story at page 93, Part 2, Vol. 28, told by "Dixie" of the cock, makes one wonder rather. I have seen the same job done more than once, but always had the joint made with the cock before the thin piece of metal was pushed out. This is perfectly easy to do with a cock of the straight-through type. It is then an easy matter to shut off the water.

With reference to the mat used, we did a similar thing when our main injection-valve spindle stripped. A double thickness of tarpaulin with four guy ropes kept the water out, and we saved dry-dock dues, but it was a nervous time, with an 8-inch hole in the ship's bottom and only canvas to keep out the water.

The cover was taken off the valve and the spindle removed. The cover was then bolted on again until the new spindle was made, when the spindle was put back in the same fashion. Of course the gland hole was blanked while the spindle was away.

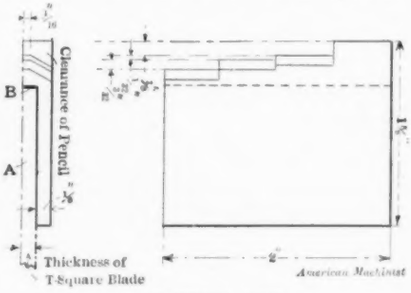
A. L. HAAS.

London, England.

["Dixie's" MS. was cut a little. It was an angle cock that was put in by Mr. Kennedy.—ED.]

A Lettering Gage.

This lettering gage will be found a valuable acquisition to any draftsman's kit. It is made of wood, and the part *A*



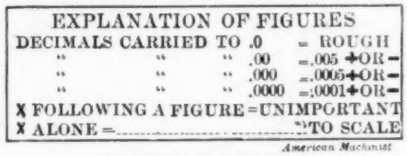
A LETTERING GAGE.

having been cut away forms a receptacle for the T-square blade, the shoulder *B* being presented against the edge of the blade, which acts as a guide when the gage is slid across the drawing. Now, by placing the pencil in the proper notch, each consecutive line can thus be drawn, the T-square meanwhile remaining stationary until the last line is reached, when it is slid downward until the top of the gage coincides with the last line, when the operation can be repeated.

PETER STEINER.

Indicating the Importance of the Different Dimensions on Drawings.

The many interesting articles that we read from time to time in the columns of the AMERICAN MACHINIST treating on various methods and systems of figuring drawings for comprehensive reading in the machine shop or toolroom, have contained a great number of valuable hints and have, I believe, done much to inspire


EXPLANATION OF FIGURES
DECIMALS CARRIED TO .0 = ROUGH
" " " .00 = .005 +OR-
" " " .000 = .0005+OR-
" " " .0000 = .0001+OR-
X FOLLOWING A FIGURE=UNIMPORTANT
X ALONE = ?? TO SCALE
American Machinist

STAMP FOR DRAWINGS.
(Actual size 1⅛x3¼".)

more careful consideration on the part of the draftsman upon whose judgment depends largely the value of the red footings on the cost sheets.

And yet the fact that this subject has agitated so much comment only serves to prove that, in this branch of drawing-room practice, there is still existing a condition of incompleteness to which, there is no doubt, can be attributed no small percentage of toolroom expense.

Let us consider, then, as a fair example, a drawing of a special milling fixture or jig, as the case may be, given over to the toolmaker together, we will assume, with such instructions and information relative to the requirements of the job as the foreman has learned or considers necessary to give.

Firstly, it must be admitted that, in the greater number of cases, especially in large establishments where interchangeable fixture work is carried on extensively, the foreman's time permits of far too little study in the way of becoming familiar with the real nature and actual requirements of the numerous jigs, tools, etc., the construction of which he is supposed to supervise. And, secondly, it is not seldom that the convictions of the foreman, and possibly of other factors in the shop government, are that the drawing is, or should be, sufficiently carried out to satisfy any inquisitive toolmaker, making quite unnecessary any further explanation as to how accurate must be the work eventually handled, or even what that work is, in some cases.

The drawing, he finds, is figured in the decimal system, which is used mostly in the finer classes of work. Here, then, is where the trouble begins. Here is where the company begins to pay out dollars for what it does not get, or, if it gets it, never knows it; not because the drawing is dimensioned in the decimal, the metric,

or the fractional system, but because there is an almost total absence of character to distinguish between important and unimportant figures. Consequently, excepting the occasional opportunities he seizes, to ask the foreman whether he will "lay off" or "indicate," or whether ".0005" is close enough for a stud (which very likely the draftsman intended hooking a spring on to) the toolmaker, for the success of the work as well as his own safety, proceeds along the one course left open to him—that is, to indicate, grind and lap all parts to a perfection worthy of much admiration, but required, the chances are, at comparatively few points throughout the fixture.

Is it a wonder, then, that in some concerns there exists a doubt as to the advantage of maintaining the toolroom? But toolrooms must be maintained, and it remains for all of us connected with, or interested in, them to so perfect our methods and simplify our practice, that as far as possible all waste time for unnecessary labor may be eliminated.

As my experience has proven to my entire satisfaction that this is one of the most serious causes of misunderstanding existing between the drawing room and toolroom, I have put the following method into practice, with results that contrast most favorably with former records:

As the designer of a machine or fixture is naturally the most capable of explaining the different features and requirements, the explanation system must start with him, and each draftsman is supplied with a copy of the following bulletin or instruction sheet, which is readily comprehended:

"The decimal system should be used throughout in dimensioning drawings, excepting where it is necessary to use standard stock, such as screws, nuts, cold rolled steel, etc., special care being used to distinguish between the different degrees of accuracy necessary to obtain the best working results by the number of decimal places the figure is carried to. A stamped form should be used on all drawings and tracing, explaining explicitly the limits permitted by the use of more or less decimal places.

"X shall be a character, used to take the place of rough dimensions of such a nature that they may be safely scaled from a blueprint, and will be explained as such upon the stamped form above referred to. This character X should also be used after any dimension that, by the splitting of an adjacent figure, has assumed more places and indicates greater accuracy than seems necessary in that case."

With this instruction sheet lived up to, the affixing of the explanation stamp to a drawing or tracing is the work of a minute. The character X is found very useful also in reducing in importance decimals that chance to be equivalents of fractions, made necessary by the use of standard drills, reamers and the like. While different companies may find it advisable to alter the variation of limits, or to otherwise modify this plan to meet the requirements of their line of work, I believe that it, or something similar, is rapidly becoming imperative, and cannot fail to give better, quicker results and allow the foreman to devote more time to matters that cannot be made self-explanatory.

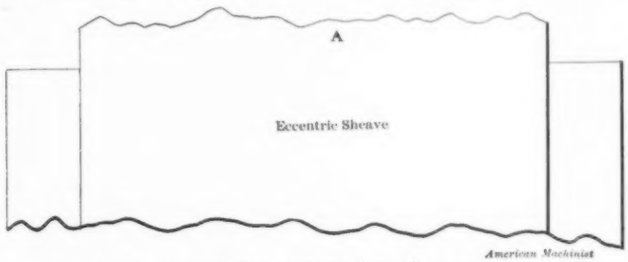
FREDERICK A. HART.

Sea Water as a Lubricant.

A few days ago, while on board a tramp steamer in Brooklyn, I saw two eccentric sheaves lying on the deck. The chief engineer was sending them ashore to be trued up. As no camera was available, I took a piece of wood, whittled one edge thin and took a "rubbing" or impression of the face of one of them where it had been in contact with the eccentric strap. The illustration is an exact reproduction of the outline of the wood.

On inquiry the chief stated that the owners allowed an amount of oil barely sufficient for the rest of the bearings of the engines and that the eccentrics had to run with water.

I have been in some very poorly found ships, but never in one where the owners were quite as mean as these.



WEAR ON AN ECCENTRIC SHEAVE "OILED" WITH SEA WATER.

In one job the tunnel bearings were greased with common beef suet, just as it came from the ox, with the fiber and tissue still in it. That tunnel smelled like the dead house in a college of surgery.

In another job we "oiled" the eccentrics with soft soap and sea water.

In any one of these jobs, if the chief had dared to remonstrate, there were 50 men ready to take his job and grease with broken stone if the owners so ordered. On some bearings, such as guides, a very little sea water with plenty of good oil will form a creamy lather that will keep guides cool where plain oil will not.

The penny wisdom and pound foolishness of many of the owners of tramp steamers would not be believed by stationary engineers. I remember one case in particular. Mr. Tod, chief engineer, waiting for a berth in Glasgow, was sent for by Mr. Thoms, superintendent of the Black and White line of tramp steamers.

Arriving in the office Mr. Thoms told him to leave by the first train and join the steamship "Hobo" at Dunkirk, in the north of France. On Tod's arrival at Dunkirk he found that the whole engineering staff was in the hospital with fever contracted in Brazil. The second and third engineers' places had been filled by men from the dock side.

No sooner was he on board than orders came to get up steam for the run to Antwerp. In those days it was not permitted to run the engines in dock, so Tod, after turning the engines with the turning gear, had to take it for granted that everything was all right.

As soon as the tide was right a tug came alongside and pulled them out of the dock. The only movements of the engine while the tug was alongside happened to be "slow ahead" and "slow astern," but as soon as the tug was clear the telegraph rang full ahead. The noise was something terrible, a boiler shop in full swing would be the silence of death in comparison to the racket made by the engines. Easing the engines down to half speed, the chief notified the captain that half speed would be as fast as he dared to run. And at this speed Antwerp was reached in due time.

On arriving in Antwerp the captain told the chief that the "Hobo" would be there for three weeks at least. Tod at once began a general overhaul. The crankshaft was sent ashore and skimmed up. As soon as finished it was brought on board and the bearings re-babbitted. Leads and been taken off all the bearings first, and the main bearings showed nearly ⅛-inch slack. All the bearings on the pump levers showed from 3-16- to ¼-inch slack; the pins on the pump levers were so much worn on the top and bottom that the bearings could not be tightened up.

The top and bottom ends were overhauled. All the pins on the pump levers had to be turned. There were also lots of minor jobs done, babbitting bearings, re-packing all glands, etc. On the air pump cover there were fifty-two ¾-inch nuts. Tod told me he hove them all overboard and got new ones, as it took fifty-seven wrenches to fit them. The boilers also received a general overhaul.

At the end of three weeks the job was in good shape and orders came to proceed to Glasgow (the home port) for general cargo for the East Indies. On arriving at the Queen's Dock Tod was sent for by the superintendent; so he spruced himself up, tucked his log book under his arm and hied him to the office in St. Vin-

cent street, expecting to be patted on the back for the fine job he had made of the "Hobo's" engines.

At the office, Mr. Thoms greeted him coldly—as is the custom of superintendents—and told him there was a directors' meeting in progress, and the directors had expressed a desire to see such a competent engineer.

In due time he was ushered into the meeting. The directors sat around a great oak table like a coroner's jury. The bill for the repairs done in the shop in Antwerp, together with his own log-book and two or three others, lay on the table in front of them. It did not take him long to find out that he was the corpse and that they had compared his log and bills with the log and bills of the chief who had preceded him. At length the managing owner (a wealthy scrap-metal dealer—this is not a hit at the "Hobo) lifted up his voice and in withering tones addressed the culprit Tod.

"We have just received a bill from Antwerp for eight thousand seven hundred and fifty-two francs and fifty centimes, incurred by you in less than three weeks. The bill is itemized and you have marked it *correct*. For the sake of argument, we will *assume* that it *is* correct. Your predecessor ran those engines for five years, and all the work done ashore during that time amounted to thirteen pounds four shillings and eleven pence."

"But," said Tod——

"There is no necessity for you to say anything, Mr. Tod. The figures condemn you. Do you realize that you have deliberately put your hand, I might say, both hands, into the pockets of the stockholders of the company that pays you wages and keeps your wife and children in ease and affluence. You have turned like a, like a ringworm and bitten the hand that caressed you. You may now go to the cashier and get your money."

And so poor Tod was "fired." I sailed with him later to the East Indies in the "Maple Branch," and when we wished particularly to rile him we referred to the ringworm incident. You will note that the managing owner put Tod's expenses in francs so as to bring them up into the thousands and make them appear large. As a matter of fact, the bill was low, considering the amount of work done.

DIXIE.

The Loose Pulley.

Referring to the loose-pulley lubricating devices which you have published, I am prompted to describe a device for that purpose that has been under my care for three years and which meets the severest conditions. It consists of a gray-iron sleeve, secured to the shaft to prevent its turning, and drilled externally with a lot of holes which pass nearly through it and are filled with grease. A pulley so fitted will run for more than a year without wear.

JAMES CATHCART.

Machining Large Segments in a 34-Inch Lathe.

Having occasion to face some castings 9 feet in diameter for large drums and having all the heavy machines engaged on other work, I have arranged to do this job on a 34-inch lathe, shown in Fig. 1. The castings—eight segments carried by the spider—are shown finished. The gray-iron spider on which the work is mounted is made in open sand; it is held in place on the lathe by bolts through the plate or ring near the center. These bolts are independent of the spider, and upon being tightened slightly give every opportunity to center the spider before the bolts are drawn tight.

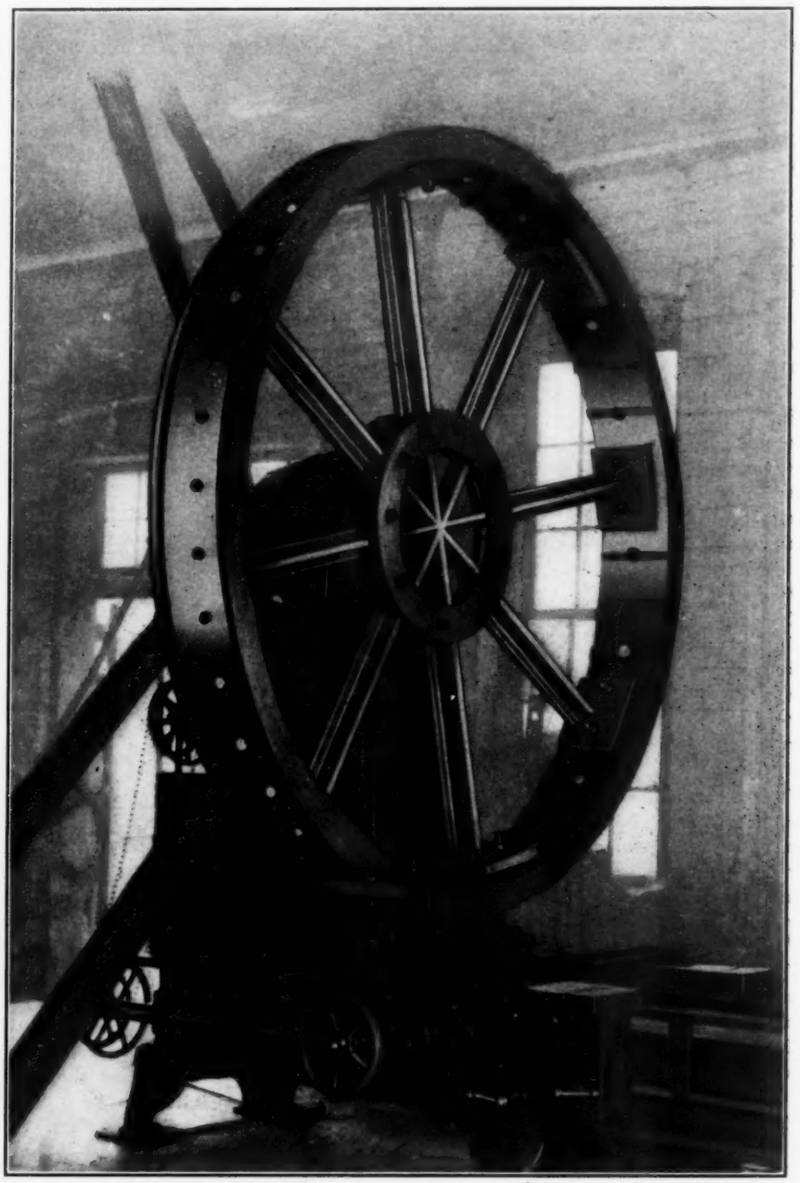


FIG. 1. A 9-FOOT JOB IN A 34-INCH LATHE.

The cutting-tool is bent to 90 degrees at the tool-post, extends across the face of the castings some 14 inches and is given a 90-degree bend upward at the cutting-edge. To hold the tool firmly and keep it from gouging in a rest is provided. This rest, as shown, is bolted to the carriage. The sprocket chain at the end of the lathe engages sprocket wheels for operating the feed. Hardwood plugs are driven into the countersunk bolt-holes in the 8 segments and the joints between segments are also filled with hardwood to keep the cutting tool from gouging in or hanging up. The method of securing the work to the spider is clearly shown, as is also the method of blocking up and bracing the headstock. The total weight of the segments and spider is 4,500 pounds. The cutting speed is 36 feet per minute, without any perceptible chatter.

The photograph shows the second lot of castings finished. I have a lot of 10-foot segments to do the same way, which will necessitate extending the spider by

adding distance pieces at the ends of the arms. It will be necessary to move the countershaft and lathe back 2 feet from the wall to give head room and raise the headstock 14 inches more.

On this lathe I had occasion, a short time ago, to finish an engine-shaft 10 inches in diameter and 23 feet long. The shaft extended some 9 feet over the end of the lathe, but I made a very satisfactory job of it by taking the tailstock off entirely and chucking one end of the shaft by the face-plate, centering the shaft with the steady rest and using 8 by 10 oak timber cut out sufficiently large to allow babbitting between wood and shaft.

In this section of the country we handle all classes of work, and at times are obliged to make changes on machines to get the work out quickly and at a reasonable cost, to compare with other factories.

The castings illustrated are part of a drum which carries 1,800 feet of 1¼-inch

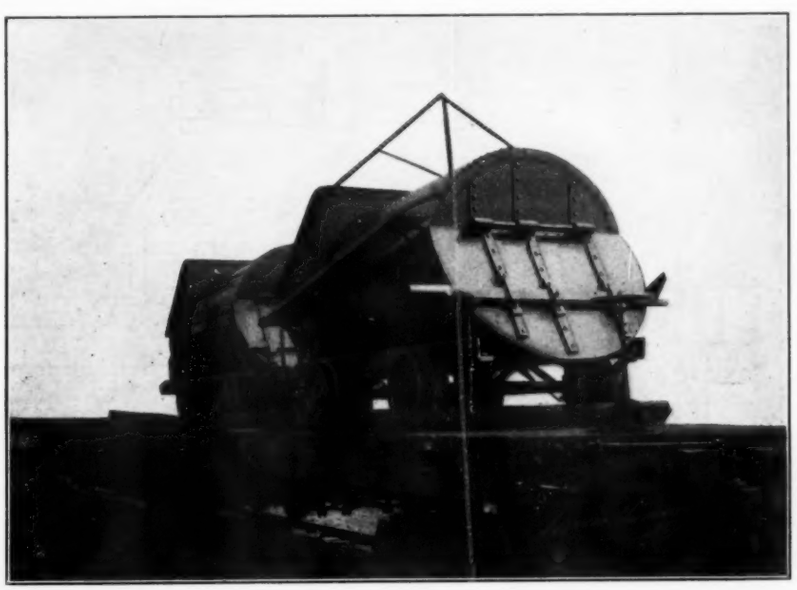


FIG. 2. A PAIR OF 6-TON COAL MONITORS.

Roebling cable, operating two six-ton steel monitors on a 40-degree incline, with a carrying capacity of 1,000 tons of coal in 10 hours. I have arranged the doors of these monitors to open automatically. The bar in the latch extends 16 inches over the monitor shell and comes in contact with a bar at the foot of the incline, which bar is set at an angle to operate the latch. A pair of monitors are shown in Fig. 2.

E. COOPER WILLS.

Bluefield, W. Va.

Variations in Molding.

"You fellows may think you are pretty smart when you get up to where you can make a casting from a good pattern and not forget to put in all the cores, or don't leave off some of the loose pieces, or do some other thing that gets the boss after you. You just want to get out somewhere where you are expected to work without having anything decent to do it with." Tom had been around a good bit and the boys sort of looked up to him because of it. He seemed to be able to make anything that came along and get a good casting the first time, and both of these things were beyond most of them. They liked to get him going, even if it did sometimes seem to them that he stretched things a little at times, and now waited for him to go on, for they knew that he would do so if not switched off.

"In some of those old jobbing shops they expect a man to be a regular artist in sand. Talk of a man being able to read drawings! Some of them expect a man to be a mind reader, and to know just what they are talking about when they wave their arms in the air and do some scratching in the sand pile with a gagger; and they expect he will be able to take any sort of a piece that they bring along and carve out shapes that aren't on it, and stop off shapes that are, and get something that is just like what they are thinking about; and then you just ought to hear them holler if the casting isn't just what they want. Even when the shop is run by a man who knows the business and wants to be reasonable, it is often so that you will have to do a whole lot of changing of the mold from what the pattern is. Such little things as making grate bars longer or shorter than the nearest right pattern, or of changing the lugs on a pump barrel, or altering the sizes on a set of brasses or some such thing as that, don't count, even if there isn't a man around that knows enough to saw off a piece of wood, for they are just the regular part of the day's work; but when a core has to be filed out of a lump of dried sand, and the place for it has to be cut out to match a chalk mark on the pattern, it is different, and you can't always blame a customer because he is not tickled to death at the casting he gets.

"When patterns are made as cheaply as they can be and are then knocked around because there isn't any place to keep them, and when the chances are small of any one of them ever being wanted again, you can safely bet that they will not be in very good shape when they are wanted, and a man has to know some of the tricks of the trade to be able to do anything with them. It is as good as a circus to see some fellows who have always worked in some big foundry where they have everything nice to work with, when they happen to have a try in such a place. I mind one fellow who happened along. He was the poorest hand to mend up a bad mold that ever I saw, and he thought he was a good molder, too. He could tell of the hard cylinders and things that he used to make in other shops, and how every tooth of his gears was perfect and how they didn't have a bit of wind in them, and a whole lot of other things, and I guess he was telling the truth too, but it was a sight to see the kind of a casting he would get from some dilapidated old pattern.

"Even from patterns that most of us thought good ones he could produce surprises. The "old man" used to do most of the bossing; he wasn't a practical molder as far as doing the work went, but he knew all of the balance of it. One day he came along after he had been looking at a casting that this man had made, and stopping aside of him, says he, 'you seem to have quiet a talent as a molder in some directions, and it might be a good thing if you would cultivate it a little further.' The shop was small and most of us could hear what was said, and we could see the tickled look that began to come over the fellow's face as he waited to hear more of it. Most of us are willing to stop our work for a bit while the boss gives us taffy.

"'In looking over your work,' continued the 'old man,' in a sort of reflective way, 'I have noticed right along that you seem to be able to take most any kind of a pattern and make something that don't look the least bit like it, or at least you can make something that looks less like the pattern than anything I ever saw any other molder make, and judging from the castings made from the same pattern there is not any limit as to what you can do in that way, as they vary from one another as much as they do from the pattern. I have been thinking that perhaps if your attention was called to it, you could get up some sort of a universal pattern which you could use to make any sort of a piece from. That would save making any more patterns, and I feel sure that the castings wouldn't be any farther away from what was wanted than some we are getting are from the patterns they are made from. Give the matter a little

thought in your spare time and see what you think of it'; and before the fellow could get his thoughts together enough to know just how to take what had been said, the "old man" had wandered on to meet some of his other troubles, and he had lots of them.

"You go and try to run a shop where you have to hire any green man that comes along to do the helping and run the cupola and make himself useful generally, and see how funny it is. I mind once when we were short of iron for the heat and the cupola man was sent into the machine shop after what scrap they had. He was told that he would find it in near the grindstone. The machinist watched him getting a wheelbarrow full and then forgot all about him. A few days after that he wanted to use the full swing rest to his lathe and couldn't find it, and he never did find it, for as near as they could find out that smart laborer had taken it, along with the other things that were near the grindstone, and had put it into the cupola."

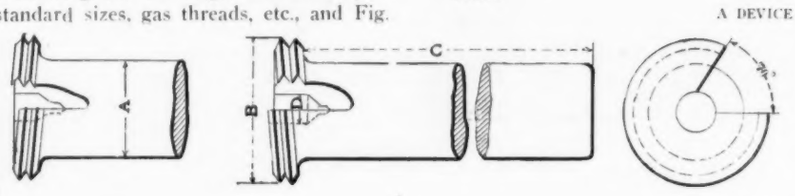
Tom had finished his dinner by this time and went to putting into practice some of the arts he had been telling about.

WILBER.

Internal Thread Chasers.

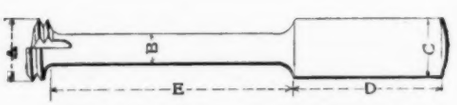
The sketches show some internal chasers which are doing good work in a factory in which I am employed. While not astonishingly new, they are vastly superior to the usual single tool, especially for the Whitworth Standard Thread, in which they give you a complete thread form. As will be seen, they are in two classes, Fig. 1 showing one for larger diameters than standard sizes, gas threads, etc., and Fig. 2 one for standard sizes. They are relieved in the lathe by turning the latter around by hand, having the gears on for the same number of threads per inch as cut on the chaser. A great advantage is gained by taking half the first thread off, so that a much larger cut can be taken when going right through a piece or when threading into a recess or counterbore. For work threaded up to a shoulder both threads should be complete. It will be found that two threads are ample, as a larger number have a tendency to dig and rip the thread. The left-hand thread can be used only in a clear hole or in one which has a fairly wide recess. Good results can also be gained by using form tools of this shape for outside chasers, and they can be relined by using the nearest cam to suit the pitch. For instance, 5 millimeter cam for 5 threads per inch. Outside chasers should be cut with the thread at an angle of 14 degrees with the chaser's body, so that they will work right up to a shoulder and clear themselves; this in American Pattern toolposts.

NOMAD.



Threads per 1	A	B	C	D
8	3/4"	1"	6°	1/2"
9	5/8"	27/32"	6°	3/8"
10	5/8"	27/32"	6°	3/8"
11	5/8"	13/16"	6°	3/8"
12	5/8"	13/16"	6°	3/8"
13	5/8"	13/16"	6°	3/8"
14	1/2"	11/16"	6°	1/4"
16	1/2"	11/16"	5°	1/4"
18	1/2"	11/16"	5°	1/4"
19	1/2"	11/16"	5°	1/4"
20	1/2"	11/16"	5°	1/4"

FIG. 1



Standard Size	A	B	C	D	E
1/8"	.26	.16	1/2"	1"	1"
1/4"	.36	.21	1/2"	1"	1 3/8"
3/8"	.42	.32	1/2"	1"	2"
1/2"	.5	.375	3/4"	5°	2"
5/8"	.6	.44	3/4"	5°	2 3/4"
1"	.7	.54	3/4"	5°	2 3/4"

FIG. 2. American Machinist

INTERNAL THREAD CHASERS.

A great deal of the output of a machine shop, learning of devices that were failures is just as useful, for it may help us to keep away from the wrong path.

The manager had complained about the price paid for manufacturing certain standard pieces, and the superintendent was busy making an investigation, cutting down too fat prices, and devising new rigs for turning out work cheaper. I was running a lathe rigged out for making pistons, and had been able to make good wages without working too hard. The superintendent thought of increasing the output of my machine by devising what is illustrated by the accompanying sketches.

Fig. 1 shows the piston, made in two pieces bolted together. The operation in which they had proposed to save time was the turning of the outside of the piston, and fitting in its ring after the body was bored and turned and the follower fitted and bolted on to the body. I used to turn one piston at a time, on a taper mandrel with a large square end, on which was fitted a strong and substantial driver, using regular roughing and finishing tools and a double cutter for facing the two sides for the ring.

They thought of turning two pistons at one time, using the mandrel shown in

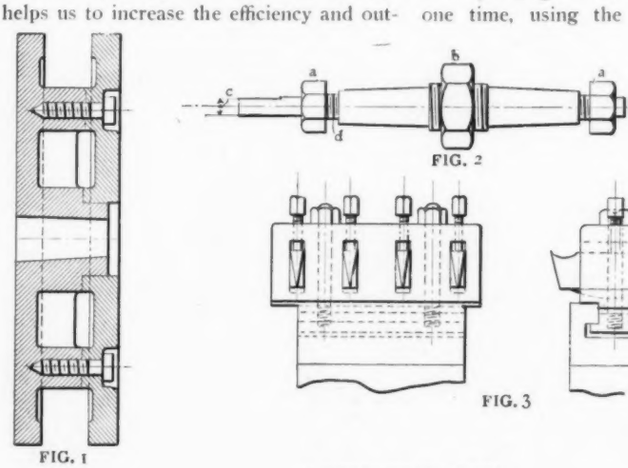


FIG. 1

FIG. 2

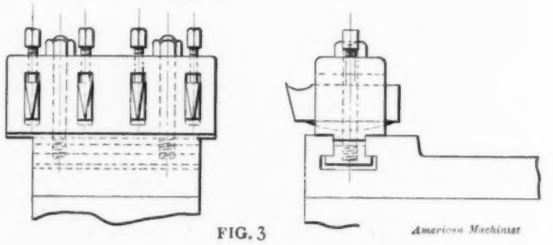


FIG. 3

A DEVICE THAT FAILED.

Fig. 2 and a tool-holder shown in Fig. 3. The two pistons were to be held on the taper of the mandrel by means of the two nuts *a a*, the central nut *b* being for releasing them from the mandrel. The tool-holder had four cutters for turning the pistons on the outside. The size of the pistons ranged from 12 to 20 inches, and the large size of the taper bore from 1⅝ to 2⅜ inches. Naturally, size *c* of the mandrel had to be slightly smaller than the diameter of the bottom of the thread *d*, and on the mandrel for turning pistons having 1⅝-inch bore it was only about 1⅛ inches.

When I heard of the proposed new way of turning the pistons I naturally criticized it—workingmen always do, and they are right 99 times out of 100, if they have been long enough at the business and are true mechanics. Before the new outfit was finished, I held that it would be a pretty tough proposition to drive the mandrels, especially the smallest one of only 1⅛ inches diameter at the end, with four cuts at the diameter of 20 inches; that the belt power of the lathe was insufficient; that the tool-holder would be a pretty

A Device That Was a Failure.

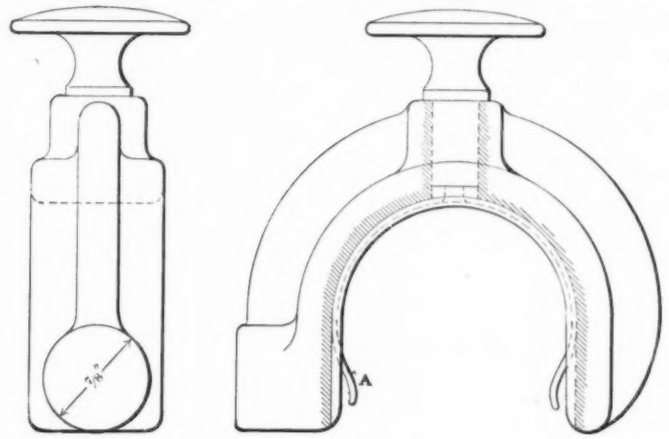
While learning of successful devices helps us to increase the efficiency and out-

heavy chunk of iron, and that removing it from the machine in order to use the double cutter for facing the piston for the ring, and then replacing it again, would require pretty strong muscles that I did not possess, or a hand hoist—and I forecasted that the whole thing was doomed to be a complete failure.

The mandrels, made of tool steel turned and ground, and the tool-holder were brought to me one day, and I was given orders to use them immediately. Of course I took the smallest mandrel and two of the largest pistons, for I had decided to give the scheme a knockout blow in the first part of the first round. I got, however, the best and strongest dog, and I used a strong angle plate, strongly bolted on the face-plate, to drive it, for I didn't want to be accused of having little judgment in that respect. I had to ask help to put the heavy tool-holder in place, as I had imagined, and when I had the tools properly set I called the foreman and started the machine.

It made a terrible racket at first, then one of the pistons got loose and turned on the mandrel. I had to tighten the nuts more, using a wrench with a long lever. I had just started the machine again, when the belts refused to pull. The belt lacer remedied that, only to find that the dog gave way and was turning on the mandrel.

I will say in conclusion that it was impossible to drive the mandrel, and that the turning of the two pistons at one time would have been such a springy job, even if we could have got a driver, that saving time on the operation would have been out of question.



Height Required	Stop to use first	Stop to substitute	Height Required	Stop to use first	Stop to substitute	Height Required	Stop to use first	Stop to substitute	Height Required	Stop to use first	Stop to substitute
1/32	1/2	15/32	17/32	17/32	—	1 1/32	1/2 .1.	15/32	1 17/32	17/32 .1.	—
1/16	1/2	7/16	9/16	1	7/16	1 1/16	1/2 .1.	7/16	1 9/16	2	7/16
3/32	17/32	7/16	19/32	1/2 .15/32	3/8	1 3/32	17/32 .1.	7/16	1 19/32	7/16 5/8 .1.	15/32
1/8	1/2	3/8	5/8	5/8	—	1 1/8	2	7/8	1 5/8	5/8 .1.	—
5/32	17/32	3/4	21/32	1/2 .5/8	15/32	1 5/32	17/32 5/8	—	1 21/32	3/8 3/4 .1	15/32
3/16	5/8	7/16	11/16	1/2 .5/8	7/16	1 3/16	7/16 3/4	—	1 11/16	3/4 .3/4 .1	7/16
7/32	3/4	17/32	23/32	3/4 .3/8	17/32	1 7/32	15/32 3/4	—	1 23/32	3/8 .3/8 .1	17/32
1/4	5/8	3/8	3/4	3/4	—	1 1/4	1/2 .3/4	—	1 3/4	3/4 .1	—
9/32	3/4	15/32	25/32	3/8 .3/8	15/32	1 9/32	17/32 3/4	—	1 25/32	3/8 .3/8 .1	15/32
5/16	3/4	7/16	13/16	3/8 .3/8	7/16	1 5/16	7/16 .3/8	—	1 13/16	3/8 7/16 .1	—
11/32	3/8	17/32	27/32	7/16 .3/8	15/32	1 11/32	15/32 3/8	—	1 27/32	1/2 .3/8 .1	17/32
3/8	3/8	—	7/8	7/8	—	1 3/8	1/2 3/8	—	1 7/8	3/8 .1	—
13/32	3/8	15/32	29/32	1/2 .3/8	15/32	1 13/32	17/32 3/8	—	1 29/32	1/2 .3/8 .1	17/32
7/16	7/16	—	15/16	1/2 3/8	7/16	1 7/16	7/16 .1	—	1 15/16	7/16 .1/2 .1	—
15/32	15/32	—	31/32	5/8 3/8	17/32	1 15/32	15/32 .1	—	1 31/32	5/8 .3/8 .1	17/32
1/2	1/2	—	1	1	—	1 1/2	1/2 .1	—	2	2	—

American Machinist

U-STOPS FOR THE VERTICAL MILLING MACHINE.

The poor mandrels, so carefully made, so shining at one time, and the tool-holder are now lying, all rusty, in a corner of the toolroom, forgotten. J. M. MENEGUS.

U-Stops for the Vertical Milling Machine.

It frequently happens that work on the vertical milling machine requires surfaces to be machined at different heights at one setting, and by raising or lowering the table, or head, or both, using the micrometer readings for guidance, not much trouble is experienced if the surfaces to be machined are only in two or perhaps three planes.

Having certain sewing-machine heads, however, which required surfaces to be machined at four different heights at the same setting, and finding it rather inconvenient to move the table, all the surfaces were machined by setting the cutter and spindle to the heights required, but the time consumed in setting the head to the micrometer led to the devising of the set of U-stops shown in the accompanying sketch. These were made of gray iron and of various heights, being accurately ground in thickness to the sizes required. The spring *A* was riveted inside the jaw, and a knob for convenient handling was attached. The top of the milling-machine spindle was provided with a split collar which could be clamped in any position. In use, if it is desired to machine one facing, say ½ inch below another, the head of the machine carrying the spindle and cutter is set for the higher facing, a ½-inch stop is placed between the pulley on top of the machine and the clamping collar, which latter is brought down to touch the stop and securely clamped in position. A cut is then taken over the work, with the head as thus set, when the U-stop is withdrawn and the spindle and cutter lowered until the split collar touches the pulley, the second cut being taken over the work in that position. Similarly, other facings can be machined at different heights by using several stops, taking one out and inserting another, etc., and although some of our machines are provided with an adjustable stop for the head with micrometer adjustments, the U-stops are preferred on account of being quicker in operation.

The spring inside the jaw prevents the stop from flying off the machine spindle when the clamping collar does not bear on the stop—for instance, when a cutter is being sunk into work to a given depth.

The table gives the stops to use for any differences in heights required from 1-32 inch to 2 inches, advancing by 1-32 inch, the stops in the set being one each, 3/8, 7-16, 15-32, ½, 17-32, 5/8, 3/4, 7/8, 1 and 2 inches. In some of the columns it will be noticed that two or more stops are to be placed on the spindle at one time.

H. A. DUDGEON.

Leicester, England.

A Crusher.

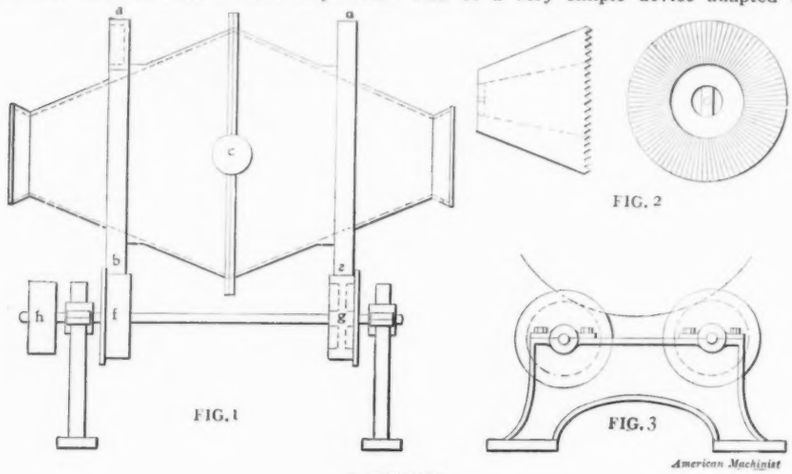
In certain lines of manufacturing, where hard substances need to be reduced to powder, no machine answers the purpose so well as a "crusher." This does the work quickly and thoroughly.

In the accompanying drawing is given a device of this kind. In construction it is quite simple and in some of its main features does not differ materially from the other machines now in general use. As shown in Fig. 1, this crusher consists of a thin shell—only ¼ inch in thickness, made in halves—conical in shape and bolted together in the middle. Both ends are left open, except that they are covered with movable lids. The object of this arrangement is to have openings through which the substances to be ground can be placed in the shell. Inside the shell, also, are placed two tumblers, as shown in Fig. 2, attached to either end by a chain. When the machine is in motion, these heavy chunks of iron roll and tumble continually, thereby grinding the hard substances into fine powder. In the middle of the shell at *c* is a small, round hole with a movable slide, designed to allow the material when pulverized to fall out.

The novelty about this machine is the manner of imparting motion to the shell. As is well-known, the old-style machines are hung upon a shaft, jutting out at either end. In this case, the entire weight of the shell plus the contents falls necessarily upon the shaft or axle, which of course must be of sufficient strength. As a consequence, the amount of friction is great, and to overcome this requires great power. In the new machine, however, these undesirable features are altogether done away with, friction being reduced to a minimum. By means of two rings fastened on the outside of the shell, as shown in Fig. 1, *a b* and *d e*, and running over four small wheels *f g*, the crusher is made to revolve with the utmost ease. A driving pulley *h* attached to the end of one of the shafts on which the wheels *f g* are placed serves to drive it.

Fig. 3 gives an end view of the supports for the shafts and wheels over which the two rings run.

The contrivance is quite simple in construction and serves well to do the work for which it is designed. HOMO.



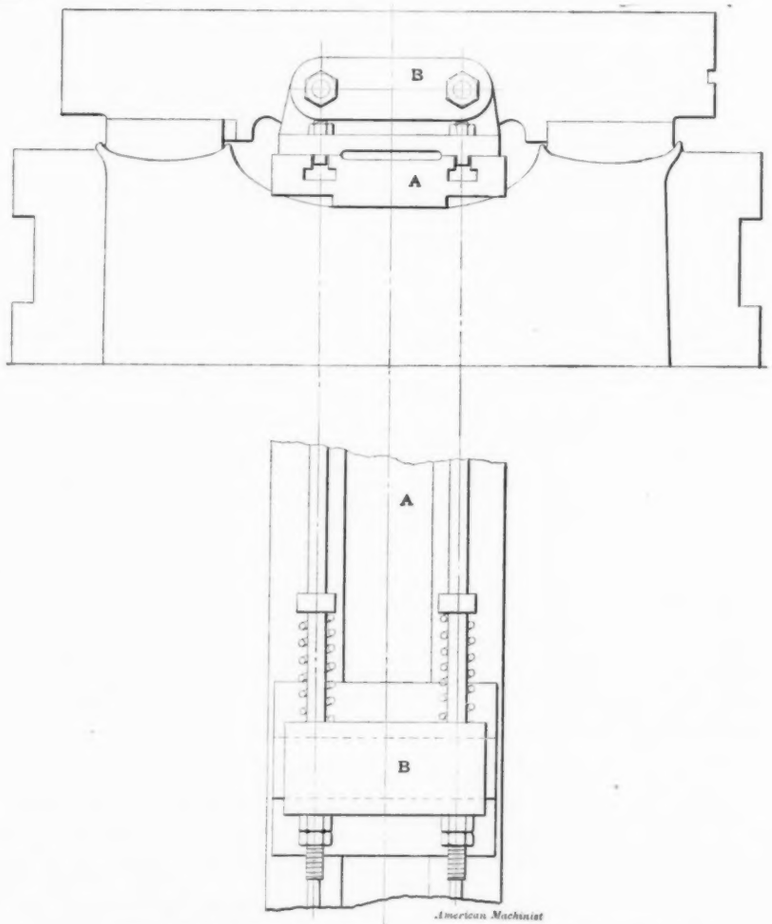
A CRUSHER.

Cushioning Device for High-Speed Planers.

The sketch shows plan and end elevation of a very simple device adapted to existing planers, of which the majority have beds that are very similar to the design shown. The box section crosswebs, are chipped to receive the long slide *A*. The bracket *B* contains the spring buffers for cushioning, and is secured anywhere on the slide by four bolts, according to the length of stroke required.

Planers that formerly cut at 15 feet per minute have been speeded up to 30 feet, the device being so effective that one can hardly hear when the table is reversed.

Yorkshire, England. HIGH SPEED.

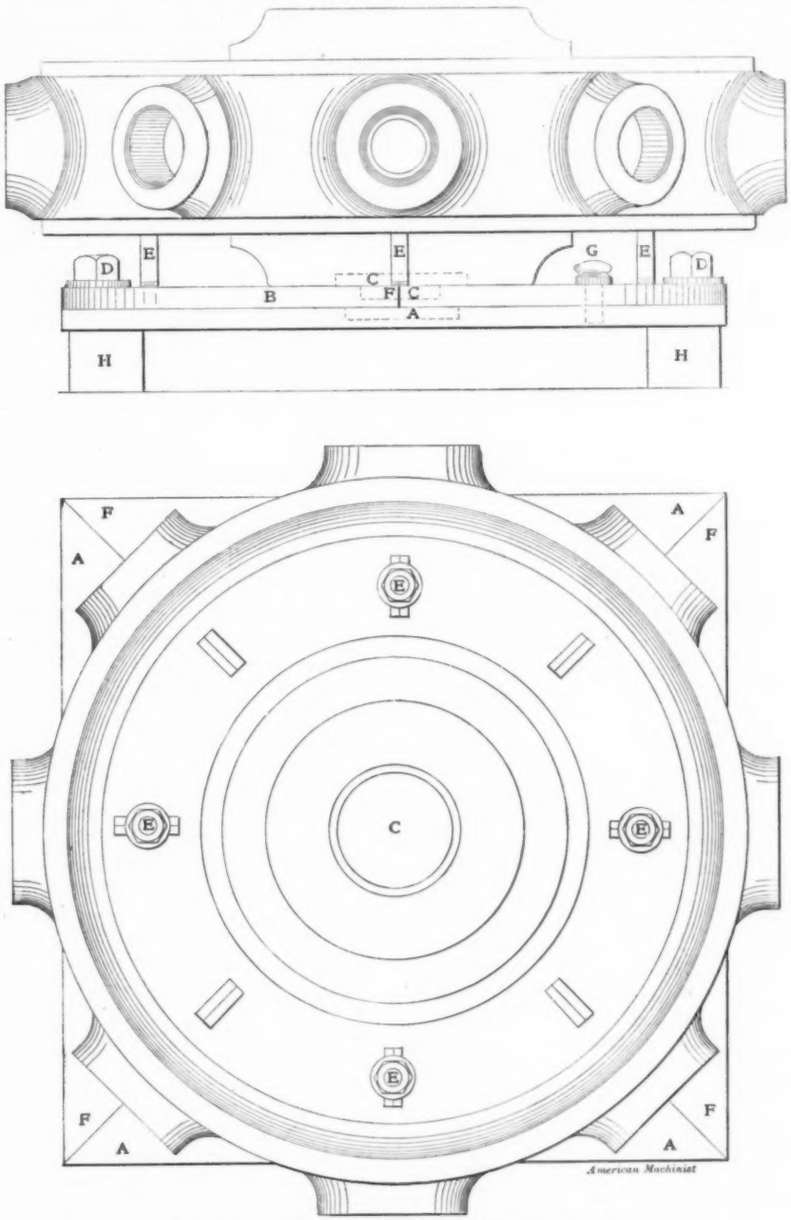


CUSHIONING DEVICE FOR APPLICATION TO EXISTING PLANERS.

Rig for Boring Arm-Holes in Flywheel Hubs.

We designed the fixture here shown for boring the arm-holes in large flywheel hubs; this we accomplish very accurately, and save much time hitherto taken to mark out, as by the method here shown no marking out whatever is required. *A* is a gray-iron plate, 4 feet 6 inches square and 2 inches thick, planed on both sides, with a recess ½ inch deep and 6 inches diameter in the center on the top, as shown by the dotted lines. *B* is a round plate, 4 feet 6 inches diameter and 2 inches thick, faced on both sides also, with a boss ½ inch deep and 6 inches diameter on the bottom side, which just fits into the recess in *A*. On the top of *B* is a recess 4 inches diameter, ½ inch deep, shown by the dotted lines, into which the loose bosses fit, to

hold the flywheel hubs. The hubs are first put in a large lathe or boring mill and faced up on the front side; they are not bored, as a rule, being cored out about 2½ inches in diameter larger than the shaft; they are "staked" on and held in position by four keys when finished. The hub is bored out about ¼ inch deep the diameter of the loose boss *C;* it is then lifted onto the round plate *B* and one of the arm-holes is set perpendicular to *F*, which is one of eight radial lines cut in *A*. *G* is a locating peg, which is a good fit in *A* and *B*, there being eight equidistant holes in *B* and one hole in *A;* this sets the hub every time a fresh hole is started. *D* are two bolts for fastening *A* and *B* together. *E* are four long studs for holding the hub secure while being bored. They pass through the cotter-holes, as shown in the plan. *H* are parallel packings of the desired height. We have used this rig both on the saddle of a large lathe and on a horizontal boring machine; passing a boring bar through the boss to bore the holes and using two cutters at once, the holes being chambered, as shown in the elevation, the inside hole being 1 inch smaller than the outside. This allows the arms to be got in much easier when building the wheel, as the arms have to be a very good fit. The bosses are also faced and finished on the outside, as shown.



RIG FOR BORING ARM-HOLES IN FLYWHEEL HUBS.

It will thus be seen that when the first hole is bored all that is necessary to set the next one is to withdraw the peg *G* and unscrew the two bolts *D*, then turn the hub round until the peg G can be got into the next hole, when the boss will be located in exact position.

England. "FLYWHEEL."

Factors of Pi.

At page 362, Geo. P. Pearce takes me to task for having stated that the difference between the true value of π and the ratio 113 : 355 is equivalent to about one inch in 150 miles.

It seems to me that the difference between 3.1415926 and 3.1415929 is equal to 3 in 31415926, or 1 in 10472000, and as there are 9504000 inches in 150 miles, this difference is equivalent to about 1 inch in 150 miles, or, to be more strictly accurate, 1 inch in 165 miles. WM. COX.

The disputed point is:

What is the difference between $\frac{355}{113}$ and 3.14159265?

$$\frac{355}{113} = 3.1415929$$

$$\pi = 3.14159265$$

The difference or error is: $.00000025$

$$= \frac{25}{100,000,000}$$

$$= \frac{1}{4,000,000}$$

$\frac{1}{4,000,000}$ expressed in length equals 1 inch in 63 miles.

To balance equation

$$\frac{113}{355} - \frac{1}{4,000,000} = 3.14159265.$$

GEO. P. PEARCE.

[According to Mr. Pearce the diameter of a circle would have to equal 63 miles before the error in its circumference due to the use of $\frac{355}{113}$ for π would equal an inch, while, according to Mr. Cox, the circumference would have to equal 165 miles before the error would equal an inch. Allowing for the added decimal place used by Mr. Pearce, the two determinations agree.—Ed.]

The method employed in landing heavy submarine telegraph cables is unfamiliar to most people, and is an interesting process. Two light ropes are first brought ashore from the cable-laying ship. One is passed round a pulley firmly secured in the ground and spliced to the second. On an agreed signal being given, the ship, which is of course anchored, hauls on one end of the rope, and a heavier rope attached to the other end is drawn in to the shore. This also passes round the pulley and is taken back to the ship, but previous to its second end leaving the vessel the cable itself is attached to it. A number of barrels are then fixed at regular intervals between the vessel and the shore, and over these the cable passes, thus facilitating the hauling of the cable. When the shore end of the cable has been made fast the barrels are released and the cable drops to the bottom. The cable steamer then heads seaward, paying out the cable as it proceeds.—*Western Electrician.*

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The "Person" in Records of Transactions.

A criticism made by Mr. B. A. Behrend, of Cincinnati, in the columns of a contemporary in respect to the use of the third person in the records of the discussions that take place upon technical papers at meetings of the American Institute of Electrical Engineers, brings to notice again the difference in practice between the various national engineering societies. In the American Society of Civil Engineers it is the practice to use the third person; that is to say, instead of presenting the words spoken by the speaker as he speaks them, the secretary of the society, or the publication committee, is supposed to inform the reader that the person named as discussing the paper said in substance certain things as follow. The American Institute of Electrical Engineers pursues the same course. It is obvious that this gives opportunity for a great deal of condensation. The one who edits the remarks of the speaker may in this way simply give in the fewest possible words the gist of what was said, and it is this consideration of time and space which impels us to present our own reports of the discussions at the meetings of the American Society of Mechanical Engineers and other technical societies in the same form. If we were to present the remarks of the speakers in the first person and in full, no issue of the paper would be nearly large enough to contain them. Unless the remarks are accurately and fully reproduced, it is, of course, impossible to quote verbatim, and the change to the third person seems the only practicable plan. The American Society of Mechanical Engineers itself, however, does not pursue this plan, but presents in its *Transactions* in the first person the discussions of papers and practically all that is said; the stenographer's typewritten report being sent to each member taking part in the discussion to be revised by him. This gives each member the opportunity of eliminating needless words, of putting his remarks in the best possible shape, avoiding tautology and other sins of extempore speaking, but not all engineers have equal facility and ability in doing this; the result being that the record as presented in the *Transactions* is quite uneven as to the quality of its English, and the form in which things are presented. While it is true that this record contains more of the personality of the speaker, and is perhaps more attractive to some members on that account, it cannot be denied that it takes up a great deal of space, and increases considerably the cost of printing and producing the volumes of *Transactions*. In going through the volumes of *Transactions* of the A. S. M. E., it is easy to pick out pages which could readily be reduced by a skilled man with a blue pencil to a single sentence, and the sentence would not only contain the substance of all that is said upon the page, but the sentence would be more apt to be read and understood than is the matter as it stands. The question of how such discussions shall be presented is, of course, one for the various societies to determine for themselves, and it should preferably be done by a vote of the members. At any rate, it is worth consideration.

Directors Who Do Not Direct.

The phase of the investigation of life insurance companies that is just now attracting a leading amount of attention is that brought out by one of the witnesses, who described the work of the usual board of directors, saying, in effect, that it is purely perfunctory, the directors being not much more than figureheads, who approve the acts of the executive officers after the acts have been taken, the business transacted at their meetings relating to such topics only as the executive officers see fit to lay before them.

One would think, from the attention which the testimony has received, that it discloses facts that are new, instead of being, as they are, well known to all who are acquainted with corporation management. Moreover, not only are they well known, but they are, it seems to us, inevitable. The boards of directors of most corporations hold four meetings a year, the duration of each being a few hours. How is it possible, during these few meetings, for any directors to acquire any independent knowledge of the infinite ramifications of the business of a modern corporation, and how is it possible for a board of directors to do more than pass on such matters as are brought before the meeting by the executive officers? We fail to see how anything more is possible or to be expected.

Moreover, except for a stipend for attending the meetings, directors receive no pay for acting as such, and should the zeal of a director lead him to take an active interest in the affairs of his corporation, he must do it without reward. Nothing is more certain in this world than the fact that the average man does not and will not do work for which he is not paid. When we consider the amount of time that would be consumed by a director in informing himself in a really effective manner of the affairs of a large corporation, and add to this the fact that the work must be done without recompense, it seems to us clear that the existing condition of things is inevitable.

The fact that a director who attempted to exercise his supposed functions would be looked upon as officious and an interloper is entirely secondary. One would think, from the comments that have been made, that it was the primary reason, and that the condition that exists is due to it as an outgrowth of usurpation of the directors' functions by the executive officers. As a matter of fact, the primary

reasons are as we have stated. It is they which have brought about the fact that directors do not direct, and out of this has grown the feeling that for a director to attempt to direct is officious, if not impertinent. To make this feeling the cause of the condition is to place the cart before the horse and substitute effect for cause.

That the condition is a desirable one, it would be idle to claim, and that it can be easily changed it would be equally idle to believe. To obtain the knowledge of the affairs of a large corporation which would qualify a director to be such in fact as well as in name, would require substantially constant contact with its transactions. But few of those having such constant contact have any wide knowledge of the affairs of such corporations, and directors have the same limitations as others. The usual director is a busy man, with affairs of his own to demand his attention, not a gentleman of leisure, devoting himself to the general supervision of other people's affairs. There are very few corporations, indeed, especially in this country, from whose stockholders a really effective board of directors could be selected, and practically none unless the directors are to be paid for the work expected from them.

Sanford Austin, of Amsterdam, N. Y., has resigned as a locomotive engineer on the New York Central Railroad, after a service covering fifty-three years, he having entered railroading as a brakeman in 1852. In 1861 he became an engineer, and for forty-four years continued as such, with but a few brief interruptions. During this long service he was never seriously injured, and his record is so clean that the company has just placed him upon the honor roll, and he will receive what is said to be the highest pension paid retired engineers, $360 per annum.

Dr. Arthur William White, professor of experimental physics in Yale University, delights in telling of his experience with an inventor of the "unlettered-genius" type who came to the professor with a model of a perpetual-motion machine.

"H'm, looks plausible," observed Dr. White, "but it won't work. What are you going to do about gravity?"

"Gravity!" said the visitor, scornfully, "t'll wit' gravity; we'll use plenty o' grease."

The United States Public Health and Marine Hospital Service has a plant for the fumigation of freight cars in Baton Rouge, La., in working condition, and from now until the quarantine established against the city is removed all freight cars that leave the city over the Yazoo & Mississippi Valley road will be fumigated. One of the results of the fumigation is that it kills all the mosquitos in the cars.

New Tools and Machine Shop Appliances.

GRINDING AND POLISHING MACHINE.

This machine is adapted for finishing both flat and irregular surfaces, the abrasive used on the disk and on the drum shown under the table being emery cloth, which is fastened in place without gluing. The drum takes a half sheet of emery cloth; that is, a piece 4½x11 inches. The

GRINDING AND POLISHING MACHINE.

polishing belt, for irregular surfaces, is made in the usual way, of webbing, and the emery is put on with glue. The taper screw at the end of the arbor is for mounting brush wheels, cotton or felt bluffs. When desired, an attachment is furnished which will take small strips of emery cloth for polishing internal surfaces, lapping holes, etc. The guide can be placed at any angle required for grinding the edges of work, and the top of the table is corrugated to allow free passage of dust from the drum. The bearings are of babbitt. Either foot-power or countershaft is furnished, as required. The machine is 3½ feet high and weighs complete 175 pounds. It is made by Chas. H. Field, 113 Point street, Providence, R. I.

New Publications.

"The Essential Data of Bevel Gearing." By E. J. Frost. 243 4½x6-inch pages. Published by the Author, Jackson, Mich. Price, $5.

Our columns, during recent issues, bear witness to the calculations necessary in laying out and making bevel gears. Not all know how to make these calculations, and to those who do the work is time consuming, and, when often repeated, irksome. The author of this book, by a large expenditure of time and patience, has calculated a series of tables from which, for all ordinary cases, these calculations may be dispensed with. The dimensions given in the tables are the face angle, the cutting angle, the back angle, the outside diameter, the backing, the number of the cutter and the pitch cone radius. The outside diameter and the backing are given for one pitch, necessitating nothing more than dividing by the pitch in each case, the tables being thus suited to any pitch. The other dimensions are used directly from the tables. The range of the tables includes pinions having from 9 to 70 teeth, and gears up to 132 teeth, the increment in the number of teeth being in all cases 1. The tables thus contain the data for gears of any pitch and having any possible combination of teeth between 9 and 132. They are prefaced by very clear diagrams and an explanation of their use. Needless to say, those who do not know how to make the calculations, as well as those who, knowing how, have many gears to lay out, will find the book an extremely useful drawing-office manual. It is well printed on thin, high-quality paper, is well bound in flexible leather and is worth its price.

Foundry Iron.

BY WM. H. BOOTH.

During the early years of our industrial progress, gray-iron took and held first place as a constructive material following wood, and was found to be superior in many ways, and in others strikingly deficient.

As new processes for the economic production of steel have appeared, a gradual but ever increasing substitution of this material for gray-iron forces one to conclude that a highly graphitic iron will, in the near future, only be used wherever weight and mass are required rather than great tensile strength or elasticity. For the frames of machine tools, for chemical purposes, or where a cheap metal is required, as for sewer pipe and outdoor work, especially, gray-iron has held and will maintain an important place.

The fact that gray-iron is being replaced in all structural work indicates its inability, even when of the best grade, to fulfil the requirements of engineers. Ordinarily, the process of refining is concluded when the metal is cast, while the only exact knowledge regarding the possibilities of a casting is obtained through its use. Rottenness may be characteristic of the mixture, or blow-holes may be present because of faulty treatment in handling and pouring. But iron is used extensively throughout the world for many purposes, and without this material machine builders would be helpless. The readiness with which it is shaped and its low cost are factors in its favor, and thou-

sands of expensive machines depend today upon the strength and homeogeneity of the gray-iron used in their construction.

As the introduction of the electric light has improved and cheapened the cost of gas, so has the use and manufacture of steel increased the quality of gray-iron. It has been found imperative to conduct the manufacture of steel along metallurgical and chemical lines. Pig iron, at once the foundryman's and steel manufacturer's source of supply, had to be improved to suit the exacting conditions of the converter, and of the open-hearth furnace. The blast furnaces have met the demand with a fine grade of metal, low in sulphur. Indeed, each carload is accompanied by a guaranteed analysis. The foundryman has thus been greatly benefited. Formerly ignorant of the constitution of his mixture, he is now in possession, at no expense to himself, of two important facts regarding his materials—the percentage of sulphur and silicon, and the brokers will often furnish a complete analysis at his request, if his order is sufficiently large. Reputable brokers may be trusted in regard to, at least, 95 per cent. of the analyses furnished by the furnaces. The remaining 5 per cent. allows for mistakes in sampling, handling, and in receiving cars. Mistakes in the laboratories of our best furnaces are rare.

The time will soon come when complete analyses will be furnished gratis with each carload of iron. Such an analysis should include silicon, sulphur, phosphorus, manganese, graphitic and combined carbon.

That a carload of iron varies in composition cannot be denied, but if sampled correctly, a very good idea of the metals and metalloids present may be obtained, and if well mixed, samples from different parts of a car give very uniform chemical results. Knowing the proportion of the elements present upon which the quality of the iron depends, the intelligent foundryman is able at all times to differentiate his mixture according to his needs and stock.

Many foundries are now equipped with laboratories and all mixtures are made up by the foreman, with the advice and assistance of a chemist. Many foremen are opposed to the recommendations of chemists. This prejudice may be founded on a non-progressive spirit, or misleading reports from different chemists. Both difficulties are being rapidly eliminated, and as the burden of responsibility has been thrown more and more upon the chemists, they have met this responsibility with more improved methods of analysis, and have produced standard samples of iron which are constantly used to check their results, and these are sold at such a reasonable price that any foundry foreman or chemist cannot afford to get along without them. An old and experienced operator claimed to be able to judge the silicon percentage of iron within five hundredths of one per cent. by fracture. When put to the test he was found to be able to estimate within one per cent., and not closer. If the additional expense of a laboratory is to be added to the foundry, the question naturally arises, what can be accomplished through its use, coupled with a knowledge of the constituents of castings?

If one were to add a pound of salt to five gallons of water, he would expect to find a pretty uniform distribution of salt after thoroughly stirring the mixture. Assuming iron to take the place of the water, and the various elements found with that metal taking the place of salt, we get an idea of the constitution of pig iron, and as there is a limit beyond which salt cannot further be dissolved in water, so in connection with silicon, carbon, etc., there is a limit to their solution or combination with iron.

Small samples of iron are remarkably constant in composition, when made from furnace stock and not from scrap, the physical treatment being the same throughout. In large castings segregation may cause a wide difference. To illustrate the uniformity of composition of drillings from samples sent to my office, I add the examples given in Table 1. The first analysis was in each case made from iron at the top of the sample; the second from that at the bottom of the sample. For the determination of each element a new sample of metal was used.

Silicon.

Sample ordinary pig iron—	
1st	2.14%
2d	2.13%
American Foundrymen's Association—	
1st	2.92%
2d	2.919%
3d	2.917%

Sulphur.

Scrap iron—	
1st	.182%
2d	.188%
No. 1 iron—	
1st	.015%
2d	.015%
High manganese iron—	
1st	.003%
2d	.003%

Phosphorus.

Pig iron—	
1st	.697%
2d	.691%
High phosphorus pig—	
1st	1.318%
2d	1.305%

Manganese.

Test bar—	
1st	.384%
2d	.386%
Casting—	
1st	.808%
2d	.808%
High manganese pig—	
1st	1.293%
2d	1.290%

Total Carbon.

Pig iron—	
1st	2.91%
2d	2.91%
Test bar, low silicon iron—	
1st	3.684%
2d	3.687%

TABLE 1. RESULTS OF DUPLICATE ANALYSES.

These show products homogeneous within experimental error. The general constitution of gray-iron being well known to engineers, we will deal only with some of the variations of the metals and metalloids which affect the stability and physical properties of the product. Sulphur is the most prominent disagreeable element found in gray-iron. It possesses no good qualities and many bad ones. It combines with iron to form a brittle sulphide with a low melting point. In the smallest quantity it produces shrinkage and hardness, the latter by driving carbon into the combined state with iron. The analyses given in Table 2 show this action:

	Si.	Mn.	P.	S.	G. C.	C. C.
1....	2.45%	.42%	.45%	.18%	2.05%	1.33%
"...	2.40	.41	.65	.09	2.95	.36
3....	2.59	.34	.67	.00	3.27	.12

TABLE 2. EFFECT OF SULPHUR.

The furnaces supply iron running from .01 per cent. to .035 per cent. sulphur. If handled by an intelligent foundryman with first-class fuel, the first should yield not higher than .045 per cent. sulphur in the casting. More often the output of the foundry runs from .07 to .10 per cent. Above .07 per cent. sulphur iron begins to get hard and increases in hardness in proportion to the sulphur content—speaking approximately. In analysis No. 1 the sulphur had driven the carbon into the combined state and had made a metal as hard as that used for cutting tools. Thin castings made from high-sulphur iron cannot be made to cool without warping.

The engineer who orders by specification ought not to allow his castings to run much above .08 per cent. sulphur, and rarely to .10 per cent. Foundrymen can furnish low-sulphur castings and should be expected to do so.

If sulphur is the foundryman's enemy, silicon is his best friend. Indeed, it may be said that gray-iron exists because of the affinity between silicon, graphite and iron. If silicon is removed, graphite gradually disappears, and we have wrought iron or steel. The sulphur, the phosphorus, the manganese and the carbon may remain, but the absence of silicon indicates the absence of graphite in any considerable quantity.

But the softness of iron is largely due to graphite. The percentage of silicon, itself a hardening agent, then largely determines the physical qualities of the future casting. No iron-clad rule can be laid down by the engineer regarding silicon. The wide-awake foundry foreman is able

to balance his mixture sometimes with silicon, sometimes with phosphorus, and sometimes with manganese. If low in silicon, the percentage of total carbon may be high, but the percentage of graphite low. If high in silicon, the graphite may also be high, making a soft casting without great tensile strength. Silicon cannot totally overcome the difficulties of low total carbon, and provision must be made for the loss of from 5 to 10 per cent. of the total silicon added in the mixture. The average silicon in ordinary castings sent to my laboratory for analysis has been as given in Table 3

Average foundry.....	2.25%—2.90%
Light castings.....	2.80%—3.00%
Heavy castings.....	2.03%—2.58%
Special.....	.80%—3.25%

TABLE 3. SILICON CONTENT IN ORDINARY CASTINGS.

It will thus be seen that while the percentage of silicon determines largely the softness of the iron, it is found present in the same class of castings in widely differing quantities. Special high silicon iron or ferro-silicon should be kept in stock by all foundrymen and used with scrap. Ferro-silicon may be purchased containing 10, 30 and 50 per cent. silicon.

Phosphorus with silicon aids in making a fluid iron, and in my experience it is usually present between .30 and .80 per cent. A specification calling for .65 per cent. phosphorus for light work and .50 per cent. phosphorus for heavy castings ought not to cause a foundry difficulty, and would answer ordinary conditions. Phosphorus is tolerably constant in the cupola and is not materially increased by ordinary fuel. Phosphorus retards the saturation of iron with carbon. Iron containing 2 per cent. phosphorus and 5 per cent. silicon may be purchased to soften a mixture.

Manganese has recently become of interest to iron users. Steel men determined the good qualities of this element several years since, and are particular to maintain a certain quantity in nearly all grades of steel. It was the first important metal added to the mixture in the form of ferro-manganese, and has maintained its reputation as a toughening material. It is found in gray iron and in steel from .25 to 1 per cent., although for ordinary purposes its presence above .60 per cent. is not recommended. In the foundry cupola it oxidizes rapidly and acts as a desulphurizing agent—produces hot and homogeneous iron. It is used in the ladle with good results, but is best added through a high-manganese pig.

Scrap iron is deficient in manganese, containing sometimes but a trace. Castings containing 80 per cent. scrap analyzed as shown in Table 4.

	Silicon.	Sulphur.	Phosphorus.	Manganese.	G. C.	C. C.
No. 1....	2.41%	.10%	.62%	.10%	1.54%	1.43%
" 2....	2.73	.074	.66	.14	2.76	.54
" 3....	1.98	.064	.60	.14	2.28	.88

TABLE 4. ANALYSES OF CASTINGS CONTAINING 80 PER CENT. OF SCRAP.

This iron was hard, brittle and honeycombed with blow-holes. No. 1 was especially difficult to drill. Such iron should be mixed with high-manganese pig, bringing the manganese to .30 per cent. or above. Great difficulty with hard, dirty iron in a large foundry led to an investigation. The percentage of sulphur was found to be high, and the manganese low, with low total carbon. An iron containing a higher percentage of manganese was substituted in the mixture, and the difficulty was very largely averted, the iron pouring easily, the castings containing less blow-holes, and being more easily machined.

Normally iron will alloy with about 4 per cent. of carbon. The presence of metals or metalloids decreases this carbon content. As iron is a frozen solution, it cannot hold more than a maximum amount of foreign matter. If one element is in excess, the other must be deficient. Thomas West is responsible for the statement that .01 per cent. sulphur is capable of hardening iron as much as .15 per cent. silicon can soften it, and that .10 per cent phosphorus equals .25 per cent. silicon up to 1 per cent. phosphorus. That manganese drives carbon into the combined state and reduces graphite is readily seen from the analyses in table No. 36 of Mr. West's book, reproduced in Table 5.

Silicon	Sulphur.	Manganese.	Phosphorus.	Combined C.	G. C.
1.34%	.076%	.54%	.087%	.61%	3.28%
1.30	.061	5.11	.076	3.41	.17

TABLE 5. EFFECT OF MANGANESE ON CARBON.

Titanium is often found present in gray iron. Its use is at present being considered to prevent the formation of blow-holes, to increase the homogeneity of the metal and to eliminate sulphur. It is possible, and probable, that some process will be discovered to entirely eliminate sulphur from gray iron in the cupola. Various metals may be added, the use of which has only been suggested, making a clean, fluid and dense metal capable of withstanding stress and strain beyond the endurance of our present castings.

Civil, mechanical and mining engineers should know the constitution of materials used in their enterprises, and be able to judge those best adapted to their conditions. Iron is still "iron" to many foundrymen, but the engineer should demand more physical and chemical tests. These supplement one another and cannot fail to be of value in determining the efficiency of gray iron.

Personal.

Frank Hooker Alfred, who for some years past has been chief engineer of the Pere Marquette Railway, is now associated with the Canadian White Company, of Montreal, as general manager.

Obituary.

Boynton Leach, formerly a lieutenant in the Navy, but for some years employed as a draftsman by the Navy Department, died in Washington, October 5.

Business Items.

The Wilmarth & Morman Company, Grand Rapids, Mich., has moved into new quarters, which have been recently equipped and which afford over twice as much floor space as the former plant, at Bridge and Canal streets. The new building is 80x100 feet, with three floors. An increased demand for the Wilmarth & Morman specialties necessitated larger quarters.

The Ingersoll-Rand Company, of 11 Broadway, New York, announces the establishment of a branch office at Houghton, Mich., under the management of T. F. Lynch, who has for several years past represented the Ingersoll-Sergeant Drill Company in the copper and iron districts of the north. At the new office a complete stock of repair and duplicate parts for all Ingersoll-Rand machinery will be carried.

The Hazelton & Donald Machine Company, of Philadelphia, manufacturer of the "Acme" metal saw table, surface plates, bench tappers, etc., announces the sale of its business and plant to the Hub Machine & Tool Company, of the same city, a new concern, managed by B. F. Lare, for many years manager of the Solomon Machine Company. The new management proposes carrying on the business started by the Hazelton & Donald Machine Company.

The W. P. Davis Machine Company, Rochester, N. Y., finding its present factory and equipment inadequate to its rapidly expanding business, is about to erect a new and modernly equipped works on the old Falls Field property in Rochester. The new buildings will contain over 60,000 square feet of floor space, will be of brick and steel construction and cost at least $75,000. A spur of the New York Central Railroad is to run to the new works and will afford abundant shipping facilities. The present Davis Machine Company is the outgrowth of a little machine shop which was started in 1872, and which, under the efficient management and business ability of Mr. Davis, has grown to be the successful enterprise that it is to-day.

Manufacturers.

The Eagle Lock Company, Terryville, Conn., will erect another factory.

Laidlaw & Co., Toronto, Ont., will build a planing mill, to cost $8,000.

George H. Hees, Son & Co., Toronto, Ont., will erect a $40,000 warehouse.

The Faultless Rubber Company, Akron, O., is erecting an addition to its plant.

The Shaw, Kendall Engineering Company, Toledo, O., will erect a new factory.

The A. F. Weymer Company, Syracuse, N. Y., will erect a new broom factory.

The Pennsylvania Rubber Company, Jeannette, Pa., is building a new addition.

The Fairmont (Minn.) Cement Stone Company is erecting a new factory building.

The Banta Furniture Company, Goshen, Ind., is doubling the capacity of its plant.

Wm. Haas & Son, of Crawfordsville, Ind., will move their handle factory to Cairo, Ill.

The Pacific Implement Company, San Francisco, Cal., will build a $125,000 warehouse.

The Wagner Electric Manufacturing Company, St. Louis, Mo., will erect a new plant.

The Elaterite Paint Company, Des Moines, Ia., is considering the erection of a new building.

The Jewett City (Conn.) Textile Novelty Company will erect three more factory buildings.

The International Gas Appliance Company, Toronto, Canada, will erect new $6,500 factory.

Palmer & Co., Chicago, Ill., are having plans drawn for an addition to the engine-room.

The Readsboro (Vt.) Chair Manufacturing Company will put up a large addition to its plant.

The Watson Ordnance Company, Pittsburg, Pa., will erect a new shop to increase its output.

Keim & Sons, Tecumseh, Neb., will install a plant for manufacturing stone for building purposes.

William C. Finck, Elizabeth, N. J., whose jewelry factory was recently destroyed by fire, will rebuild.

The plant of the Lee Broom & Duster Company, Everett, Mass., was destroyed by fire; loss, $30,000.

The W. P. Davis Machine Company, Rochester, N. Y., will erect a new plant at a cost of about $75,000.

The furniture house of John G. Seeger & Sons, Buaffio, N. Y., was burned, causing a loss of $60,000.

The Harlan & Hollingsworth Company, Wilmington, Del., will erect a $10,000 power-house at its plant.

The W. A. Paterson Company, carriage builder, Flint, Mich., has let contract for a new four-story factory.

The extract plant of the G. Bruning Company, Lynchburg, Va., was burned, entailing a loss of about $25,000.

The Geneva (Ill.) Foundry Supply Company has been formed. John T. Peterson, of that place, is interested.

The Fayetteville (Tenn.) Flouring Mill Company, recently organized, has purchased a site on which to erect a mill.

The Beaumont Manufacturing Company, Spartanburg, S. C., will build a new mill for producing sheetings and warps.

E. A. Turnbull, Grand Ledge, Mich., will erect a chair factory, which it is said will be the largest of its kind in the State.

The A. George Schulz Company, Milwaukee, Wis., manufacturing paper boxes, has had plans drawn for a $150,000 factory.

The Kruger Manufacturing Company, to build automobiles, has been organized at Milwaukee, Wis. Julius Roehr, president

The Grand Trunk Railway will enlarge the capacity of its car at Port Huron, Mich., giving employment to 300 additional men.

The Foote Manufacturing Company, Nunda, N. Y., will enlarge its factory in order to supply the demand for concrete mixers.

The White Enamel Refrigerator Company, St. Paul, Minn., will make several additions to its plant, at an expenditure of $19,000.

The Kerr-Murray Manufacturing Company, making gas-works machines, etc., Ft. Wayne, Ind., will build an addition, to cost $5,000.

The W. J. Jennison Company is rebuilding its burned mill at Appleton, Minn. It will be equipped with the most improved machinery.

The Grand Rapids (Mich.) Automatic Screen Company is negotiating for a site in Toledo, O., where it will erect a $10,000 plant.

The Southern Machine Works have been formed at High Point, N. C. H. Burns and Geo. T. Wilson, of that place, are the promoters.

The Weis Manufacturing Company, of Toledo, O., will move its plant to Monroe, Mich. The company manufactures office supplies and furniture.

The North American Storage Company will erect a cold-storage house at Oakes, N. D., which will have a cooling capacity for 500,000 pounds.

The Barnesville (Ga.) Paper Box Company, a new corporation, will put up a factory. Cook Taylor, G. L. Summers, of Barnesville, incorporators.

The American Press Cloth Company, Columbia, S. C., recently organized, has started to erect a plant. John J. Seibels, president and treasurer.

The planing and wood-carving departments, as well as engine-room, of the Willman Lumber Company, Hartford City, Ind., were destroyed by fire.

The Hoffman-Carr Manufacturing Company, of New York, will soon begin the erection of a waste product mill at Spartanburg, S. C., to cost $200,000.

The Dozier & Gay Paint Company has been organized at Jacksonville, Fla.; capital, $50,000. Screven Dozier, J. H. Gay and others are the incorporators.

The Columbus (Ga.) Concrete Supply Company has been organized with a capital of $50,000. Incorporators, John F. Weathers, Ernest L. Hill and others.

The Erin Manufacturing Company has been organized at Erin, Tenn., for the purpose of manufacturing a newly invented hay press. E. W. Rauscher, president.

The Franklin Brewing Company, Columbus, O., will make improvements to its plant, to cost $100,000. These include a new bottling-house and a new boiler-house.

The Willow Springs Brewing Company, Omaha, Neb., is erecting two new buildings, to be used as storage houses, and in the near future will erect a new brew-house.

A new refrigerating plant, to cost $500,000, will be built in Kansas City, Mo., the prime mover in the undertaking being the Merchants' Refrigerating Company, of that city.

J. B. Tuck has purchased the property of the American Road Roller Company at Groton, N. Y., and has formed a new company, known as the Monarch Road Roller Company, with a capital of $250,000. The company will manufacture road rollers, traction engines, street sweepers, etc.

The Marine Manufacturing & Supply Company, 158 South Street, New York, is moving its manufacturing department to New Brunswick, N. J. The company, which makes steering wheels, windlasses, hoisting winches, etc., is in the market for new machinery, and will be glad to receive manufacturers' catalogues.

New Catalogues.

The Cordesman Machine Company, Butler street, Cincinnati, O. Catalogue of woodworking machinery. Illustrated. 9½x12, paper.

Keystone Chuck Company, McKeesport, Pa. Circular illustrating and describing patent reversible four-jaw independent lathe chuck.

American Steam Pump Company, Battle Creek, Mich. Catalogue of Marsh tank and vacuum pumps. Illustrated. 6½x7½, pp. 24, paper.

York Manufacturing Company, York, Pa. Catalogue of vertical single-acting ice and refrigerating machines. Illustrated. 6x9, pp. 23, paper.

New Bedford Textile School, Purchase street, New Bedford, Mass. 1905-1906 catalogue of the day department. Illustrated. 6x9, pp. 62, paper.

De Laval Steam Turbine Company, Trenton, N. J. Booklet describing briefly different types of turbines and motor-driven machinery. Illustrated. 3½x6½, pp. 22, paper.

Buffalo Forge Company, Buffalo, N. Y. Booklet showing complete line of new punches, shears and angle-iron cutters brought out by this company. Illustrated. 6½x10½, pp. 8, paper.

Hammacher, Schlemmer & Co., Fourth avenue and Thirteenth street, New York. Circular illustrating and describing "Tourist Autokit," which should be of interest to those having to do with automobiles.

Atlas Engine Works, Indianapolis, Ind. Catalogue No. 125, describing fire-tube boilers. This contains detailed dimensions and specifications and various line and half-tone engravings. 6x9, pp. 72, paper.

Lucas Machine Tool Company, Cleveland, O. Pamphlet entitled "The Janitor and the Librarian," which calls attention to the "Precision" boring, drilling and milling machine made by this company. 3½x6, pp. 4, paper.

National Electric Co., Milwaukee, Wis. Bulletin No. 355, illustrating and describing direct-current belt-driven generators. 7x10, pp. 12. Bulletin No. 357, illustrating and describing Christensen air-brake equipments. 7x10, pp. 12.

Westinghouse Electric & Manufacturing Company, Pittsburg, Pa. Circular No. 1120, illustrating and describing No. 113 railway motor. 7x10, pp. 15. Circular No. 1123, illustrating and describing prepayment watt-meters. 7x10, pp. 6, paper.

Independent Pneumatic Tool Company, 1255-57 First National Bank Building, Chicago, Ill. Circular illustrating and describing some "Thor" piston air drills, reversible wood-boring machines and pneumatic riveting, chipping and calking hammers.

Laidlaw-Dunn-Gordon Company, 114 Liberty street, New York. Bulletin L-508, describing the improved Cincinnati air compressor. Illustrations showing the adaptation of the compressor to different methods of driving are shown. 6x9, pp. 36, paper.

Gisholt Machine Company, Madison, Wis. Catalogue J-4, descriptive of the Gisholt lathes, boring mills and universal tool grinders. This is a handsome book, printed on fine coated paper and containing excellent half-tone illustrations. 8x10, pp. 39, paper.

Wellman-Seaver-Morgan Company, Cleveland, O. Catalogue describing charging apparatus for open-hearth furnaces and charging and manipulating apparatus for reheating furnaces. This contains half-tone illustrations of various installations and a list of users. 9x12, pp. 80, paper.

Cincinnati Milling Machine Company, Cincinnati, O. 1905 catalogue of complete line of milling machines and attachments, including four new sizes of plain millers. This contains specifications, dimensions, speed tables for high-speed steel cutters, and very fine half-tone illustrations.

The Switchboard Equipment Company, Lewis Building, Pittsburg, Pa. Bulletin No. 1, illustrating and describing direct-current circuit breakers, overload release. 6x9, pp. 26. Bulletin No. 2, on direct-current circuit breakers, overload release, for motor service. 6x9, pp. 8. Bulletin No. 3, on combination protection panel for motor service. 6x9, pp. 8.

Northern Electrical Manufacturing Company, Madison, Wis. Bulletin No. 51. This contains descriptions, ratings and dimensions of Northern ring type machines for power and lighting service, and some illustrations of applications of heavy motor drives. 7x10, pp. 24. Leaflet No. 145, devoted to electric forge blower equipments having a capacity of 75 to 425 cubic feet of air per minute.

De La Vergne Machine Company, New York. 1905 catalogue of "Hornsby-Akroyd" oil engines. This has table of tests, line engravings, illustrations of various installations, list of engines in operation in the United States War Department and a number of testimonials. 6x9, pp. 74, paper.

F. Wesel Manufacturing Company, New York. Souvenir commemorating the twenty-fifth anniversary of the founding of the business of this company. This is very interesting, telling of the development of the business, which is the manufacturing of a complete line of machines and tools used by electrotypers and stereotypers, and also printing and photo-engraving machines.

We have received from the Westinghouse Companies' Publishing Department, Pittsburg, Pa., pamphlet entitled "Westinghouse Railway Apparatus," to be distributed at the convention of the American Street Railway Association at Philadelphia, which describes in a general way the motors and generators for railway work made by the Westinghouse Electric & Manufacturing Company. Illustrated. 6x9, pp. 20, paper.

General Electric Company, Schenectady, N. Y. Bulletin No. 4417, illustrating and describing generating station and sub-station switchboards for continuous-current railway systems operated by three-phase generators. 8x10, pp. 32. Bulletin No. 4418, on the synchronism indicator. 8x10, pp. 8. Bulletin No. 4419, on the new G. E. high efficiency high candle-power incandescent units. 8x10, pp. 4. Bulletin No. 4420, Thomson high torque induction test meter, type IB. 8x10, pp. 4. Flyers Nos. 2163, 2164, 2165, illustrating and describing G. E. standard key and keyless sockets, concentric diffuser for incandescent lamps, electrolier key and keyless sockets. Pamphlet entitled "Electricity Versus Steam for Train Haulage." This contains a paper on "Developments in Electric Traction" by W. B. Potter, read before the New York Railroad Club, and also an article, "The Electrification of Trunk Lines," by L. R. Pomeroy. Supply Catalogue No. 7590 of G. E. enclosed fuse cut-outs and fuses. Illustrated. 5½x7½, pp. 32.

Miscellaneous Wants.

Advertisements will be inserted under this head at 25 cents a line each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Caliper cat. free. E. G. Smith, Columbia, Pa.

Punches & dies. Wal.M.Wks., Waltham, Mass.

Will buy or pay royalty for good patented machine or tool. Box 282. AMER. MACH.

Light and fine mach'y to order; models and elec. work specialty. E. O. Chase, Newark, N. J.

Dies and tools for sheet metal designed and constructed; estimates. J. V. Woodworth, 367 Vernon ave., Brooklyn, N. Y.

Wanted—Patented specialties of merit to manufacture and market. Power Specialty Co., 500 Washington ave., Detroit, Mich.

Work wanted for a Cleveland automatic lathe; handles 2 in. and under. The Earle Gear & Machine Co., 141 Oxford st., Philadelphia.

Wanted—A complete set of drawings for either steam or gasolene power automobiles about 15 H.P. G. A. Robertson, 383 Lansdowne ave., Westmount, Quebec, Canada.

Clock work and intricate mechanical instruments; meter counters, water, gas or electric; recording devices; special movements to order. D. S. Plumb, 57 E. Park st., Newark, N. J.

One second-hand combination tilting table pattern shop saw, also 26 or 28 in. thickness planer; must be in good condition and low price. Address Dayton Pattern Works, Dayton, O.

Mechanical engineer of ability lately filed application for patent for an entirely new machine; industry for which it was invented anxiously awaiting the marketing of same; would like to correspond with parties desiring to control and manufacture a meritorious and profitable machine. Box 662, AM. MACH.

Wanted—Near New York, a large factory building suitable for a machine shop for building heavy machines and also light machines, 1,200 to 20,000 lbs., having traveling cranes, or suitably built to allow installing traveling cranes; no objection to a factory already equipped with modern tools. Address "National," care AMERICAN MACHINIST.

For Sale.

For Sale—Complete lot designs, patterns, jigs and stock of complete and up-to-date line of "sensitive drills." Box 670, AMER. MACH.

Business Opportunities.

Wanted—A shop to build by contract machine weighing 4,000 lbs.; first-class work required. Address, giving information regarding equipment, Box 653, AMER. MACHINIST.

Wanted—Engine manufacturer to build our patented, single-acting, high-speed steam engine on royalty basis. Engine is now successfully marketed for automobile and power-boat use and in large demand for various stationary purposes. Address D. W. 101, AM. M.

For Sale—A well-established, paying, metal-working plant in important manufacturing center; superior shipping facilities; equipped with best up-to-date machinery; good, substantial, well-lighted brick building and perfect site. Large orders in hand. Price $75,000 complete, or would sell large interest to good business man or capable, active shop superintendent. Reason for selling, advanced age and ill health of proprietor. Full particulars to interested parties on application. Address "Opportunity," care AMERICAN MACHINIST.

I am still looking for a partner with some cash, say five or ten thousand. I have a good business. I am a young man, have a technical education, 7 years' practical experience, and natural ability for designing and developing light machinery. The machines produced give satisfaction, and, as they save money, are in demand by firms able to pay for them, who really must have them to keep up with others. I need a straight, clean, business man, with mechanical experience if possible, to help me develop this first-class business. Every word of this is honest and capable of proof, and I only want to correspond with those who will meet me on the same level. Address, in confidence if desired, Box 686, AMER. MACH.

Wants.

Situation and Help Advertisements only inserted under this head. Rate 25 cents a line for each insertion. About six words make a line. No advertisements under two lines accepted, and no advertisements abbreviated. The cash and copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded; but replies will not be returned. If not forwarded they will be destroyed without notice. Original letters of recommendation or other papers of value should not be enclosed to unknown correspondents. Only bona fide situation want or help want advertisements inserted under this heading. Agency advertisements must be placed under Miscellaneous Wants.

Situations Wanted.

Classification indicates present address of advertiser, nothing else.

CONNECTICUT.

Mechanical engineer, several years' experience as draftsman and designer, wishes position. Box 695, AMERICAN MACHINIST.

MASSACHUSETTS.

Mechanical draftsman, 6 years' experience in factory engineering, open for engagement. Box 687, AMERICAN MACHINIST.

An experienced machine shop foreman on engines and electrical machinery desires position. Box 678, AMERICAN MACHINIST.

Experienced mechanical draftsman, 27, German, technical graduate, wants to change position. Box 649, AMERICAN MACHINIST.

Wanted—A position as superintendent or general foreman; 18 years' experience on textile machinery and high-speed engines; designer of special tools and jigs; A1 references. Box 677, AMERICAN MACHINIST.

NEW JERSEY.

Experienced superintendent desires change; systematic methods; thoroughly practical; good references. Box 688, AMER. MACHINIST.

Capable man, technical graduate, wide shop, drawing-room and executive experience, wishes position of trust; could invest in growing concern. Box 689, AMERICAN MACHINIST.

A competent mechanical engineer seeks a position as chief draftsman and superintendent with a progressive concern, to design and manufacture a line of engines, pumps, hydraulic machinery or complete power plants. Address "Thorough," care AMER. MACHINIST.

NEW YORK.

Experienced cost clerk desires position. Box 679, AMERICAN MACHINIST.

Mechanical draftsman wishes position. Address Box 694, AMERICAN MACHINIST.

Mechanical draftsman, having 7 years' experience and familiar with shop work, desires position. Box 681, AMERICAN MACHINIST.

Young man wishes a position as assistant mechanical draftsman; graduate of Cooper Institute. Box 698, AMERICAN MACHINIST.

First-class draftsman, experienced designer on tools and fixtures for interchangeable manufacturing, desires change; best references. Box 676, AMERICAN MACHINIST

General foreman, responsible man, progressive, experienced in high-grade duplicate and general machinery, expert mechanic, is open for engagement. Box 672, AMER. MACHINIST.

Position as superintendent or master mechanic desired by expert in manufacture of sheet metal specialties or tools for same; at present hold similar position. Box 692, A. M.

Wanted—A position as superintendent or general foreman, by a thorough, up-to-date mechanic; 20 years' experience in the machine-tool and automobile business. Address Box 597, AMERICAN MACHINIST.

Graduate engineer, age 30, desires position as chief draftsman, engineer, leading designer; 2 years' shop, 8 years' office experience as draftsman, inspector, leading designer on special and small machinery, instruments, jigs, fixtures, gages; inventive, hustler, and bound to win; salary $135 to $150. Box 622, A. M.

In Greater N. Y. or vicinity, the superintendency or mechanical supervision of some good, progressive manufacturing establishment, by a man of rare abilities and exceptional qualifications, in the prime of a healthy life (38 years of age); heavy, medium or light manufacturing; practically familiar with all details of mechanical production of to-day; a cost-reducer and systematizer and all-round expert in the factory; have an absolutely clean record, with exceptional executive ability and long experience. Unless you mean business and are willing to pay a salary commensurate with value received, do not answer this. Address Box 634, AMER. MACH.

PENNSYLVANIA.

Wanted—Position, by young man with 15 years' experience, shop and office, in electric manufacturing and machine tool companies. Box 671, AMERICAN MACHINIST.

Foreman patternmaker, accustomed to high-speed and four-valve engine and general work, desires change; 8 years foreman. Address "M. E.," care AMERICAN MACHINIST.

Designing draftsman; automatic machines, jigs, fixtures; familiar with modern manufacturing requirements; position as superintendent or designer; technical; married; go anywhere. Box 699, AMERICAN MACHINIST.

Mechanical and architectural engineer and draftsman is open for engagement; Corliss engines, blowing and pumping engines, gas engines, power stations; competent to take charge. Address Box 630, AMER. MACHINIST.

Help Wanted.

Classification indicates present address of advertiser, nothing else.

CANADA.

Wanted—General draftsman; one familiar with turbine water-wheel, sawmill and pulp mill machinery design; state age and experience. Apply to Box 650, AMER. MACHINIST.

CONNECTICUT.

Wanted—First-class blacksmith, accustomed to machine forging and use of steam hammer; state age and wages expected; none but first class men need apply. Box 623, AM. MACH.

ENGLAND.

Draftsman wanted in British works of old established engineering firm, to design mainline and other locomotives, and best classes mining machinery, engines, pumps, etc.; must have sound theoretical training as well as practical experience with above mentioned work; must be capable for ready and accurate calculations; must have capacity to take charge; state experience fully, also age and salary expected. Address B. D., care *Railway Gazette*, Queen Anne's Chambers, Westminster, London, S. W., England.

ILLINOIS.

Foreman for sheet metal works in Chicago, capable of taking charge of shop employing 100 to 200 men, and working from No. 27 iron up to ¼ plate; must be up to date, familiar with all sheet metal working tools, able to lay out; in answering, state past experience, present occupation, wages and reference. Address Box 643, AMERICAN MACHINIST.

MARYLAND.

Wanted—An experienced designer of automatic machinery; must be practical—not a theorist; state extent of experience and on what class of work; if at present employed;

state age, references and salary desired. Address Box 691, AMERICAN MACHINIST

MASSACHUSETTS.

Wanted—An assistant superintendent for a manufacturing establishment employing about 150 hands, on small interchangeable work; must be thoroughly conversant with modern shop practice, well up on cost systems and able to handle men; applicants are requested to state where now employed, state salary expected and furnish references as to character and qualifications. Address Box 673, AM. M.

Foreman wanted to take charge of toolroom employing 30 toolmakers on accurate jig and tool work; also foreman wanted for machine shop producing accurate interchangeable parts; to capable young men of good character, who can show their ability, good wages will be offered; our shops are modern and are located in the Middle West, where desirable homes can be had; only those who can furnish first-class references need apply. Box 680, AMERICAN MACHINIST.

NEW JERSEY.

Wanted—An experienced and skillful mechanical draftsman, also an experienced and skillful patternmaker. Address or call on S. R. Krom, 115 Plymouth st., Jersey City, N. J.

Lathe, planer and boring mill operators wanted for night shift; those accustomed to machine tool work preferred; steady work and good pay to good men. Address the Pond Machine Tool Co., Plainfield, N. J.

Wanted—Several first-class diemakers on high-grade work; sub-press diemakers preferred; steady work and good wages for good workmen; no labor trouble. Sloan & Chace Mfg. Co., 297 Washington st., Newark, N. J.

Wanted—At once, two first-class turret lathe operators, capable of demonstrating to customers the capabilities of the Pond rigid turret lathe; good pay to good men; none but first-class mechanics in this line need apply. Address Pond Machine Tool Co, Plainfield, N. J.

NEW YORK.

Typewriter works wants high-grade toolmakers, experienced on fine dies and fixtures. Box 690, AMERICAN MACHINIST.

Salesman wanted by New York machinery house, for general outside traveling; must be thoroughly experienced. Box 696, AM. MACH.

Wanted—A first-class machinist for erecting, installing and testing stationary gas engines; unless thoroughly familiar with this line of work please not apply. Box 668, A. M.

Wanted—Several A1 mechanical draftsmen; only those having had 3 or more years' practical experience need apply. Engineer in Charge, Drafting Department, General Electric Co., Schenectady, N. Y.

Wanted—Mechanical draftsman with some experience in superintending erection of steam and machinery plants; good opportunity for ambitious man to rise with growing concern. Box 674, AMERICAN MACHINIST.

Wanted—Able mechanic who is competent to set up and take charge of the operation of automatic screw machines and milling machines; state age, experience and salary expected. Box 685, AMERICAN MACHINIST.

Wanted—Immediately, several expert designers, experienced in designing jigs, dies and fixtures for small machine manufacture, also first-class toolmakers for the same work. Address P. O. Drawer No. 7, Syracuse, N. Y.

Wanted—General foreman of ability and integrity, for factory manufacturing a general line of brass and bronze work, where lower costs and the best of work are desired; give references, age and salary desired. Box 684, AMERICAN MACHINIST.

Several draftsmen wanted; location, N. Y. city; original designing ability not essential; good positions to good men who are quick and accurate at dimensions; state age, experience, nationality and salary expected. Box 666, AMERICAN MACHINIST

Toolmakers on punches and dies, screw machine tools, jigs and fixtures; only first-class men wanted; all applications considered confidential; state experience and specify which line of work you are best fitted for. Address Box 693, AMERICAN MACHINIST.

Wanted—Draftsman, experienced in crane work; one capable of calculating stresses and designing to some extent preferred; give references, age, experience and salary expected; position permanent if satisfactory. The General Pneumatic Tool Co., Montour Falls, N. Y.

Wanted—Superintendent with experience in the manufacture of first-class machine tools; must be energetic, with good executive ability; technical graduate preferred; an excellent opportunity for the right man; state age and past experience. Address "Machinery Manufacturer," care AMER. MACHINIST.

Wanted—Competent foundry foreman; energetic and experienced man who can handle help to best advantage, well versed in modern foundry practice; 18 molders; castings only for our own machine shop; references required; state experience in detail, age, etc. Niagara Machine & Tool Works, Buffalo, N. Y.

Wanted—A "master mechanic," by a large manufacturing concern; must thoroughly understand engines, boilers, dynamos, motors, piping, millwright and carpenter work; must have good executive ability and be able to take charge of entire upkeep of plant; give detailed experience, age, salary expected and references. Box 667, AMERICAN MACHINIST.

Wanted—Foreman for machine shop manufacturing special machinery and doing general repair work; must have ability and push, be familiar with modern machine shop practice, systematic and thoroughly capable of handling men to the best advantage; splendid opportunity for the right man. Address, giving full information as to experience, age, references, etc., Box 682, AMERICAN MACHINIST.

OHIO.

General foreman wanted by a concern manufacturing electric cranes; 40 to 60 men; party must be an experienced machine and floor hand; would prefer one who is familiar with crane or engine work; give age, past and present employers, wages, etc.; all replies will be treated strictly confidential. Box 669, AMERICAN MACHINIST.

Wanted—Assistant foreman in the manufacturing department of an adding machine factory in the Middle West; young men who are ambitious, progressive and anxious to forge to the front will find this their opportunity; a good moral character and executive and mechanical ability necessary; state wages desired, experience and full particulars. Address Box 683, AMERICAN MACHINIST.

Wanted—Foreman for screw-making department of a sewing machine factory in Middle West; none but first-class men with a good reputation need apply; must be a hustler, of middle age, and thoroughly up to date in all the most improved methods, especially with all makes of automatic screw machines; permanent position with good pay for the right man; state references and wages expected; replies confidential. Address Box 697, AM. M.

Wanted—Foreman to take charge of our inspection department, which includes raw stock as well as finished parts; none but first-class men of good character, good judgment and hustlers with executive ability need apply; the position is one of responsibility, and pays good wages to one who can get work out of others and sees that they use their best judgment as well; a man with mechanical experience preferred; give full particulars. Address National Cash Register Co., Dayton, O.

PENNSYLVANIA.

Vise hands or fitters on machine tool work; modern shop; no trouble; applicants should state past experience. Standard Engineering Co., Ellwood City, Pa,

Wanted—Two first-class, experienced machinists at once, for tool and jig work; must be accurate workmen. Address "X. Y.," care AMERICAN MACHINIST.

Wanted—Draftsman familiar with designing and manufacturing power transmission appliances; must have shop experience. Address Box 675, AMERICAN MACHINIST.

Wanted—A first-class draftsman; preferably one who is familiar with motor and controller work. Address, giving experience, Ridgway Dynamo & Engine Company, Ridgway, Pa.

Foreman to take charge of modern equipped machine shop; 100 men; must be accustomed to modern methods of rapid production in a miscellaneous class of work; reply promptly, giving age, experience and salary expected. Address "X. Y.," care AMERICAN MACHINIST.

WEST OF MISSISSIPPI.

Clarinet or 'cello player wanted for small pleasure orchestra; permanent employment for first-class mechanical draftsman or good warehouse stock clerk; location, Tennessee. Address Box 658, AMERICAN MACHINIST.

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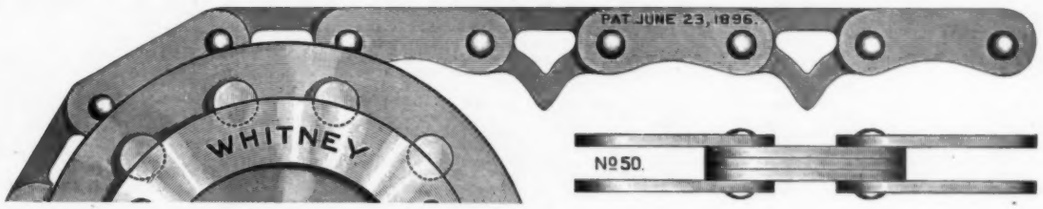

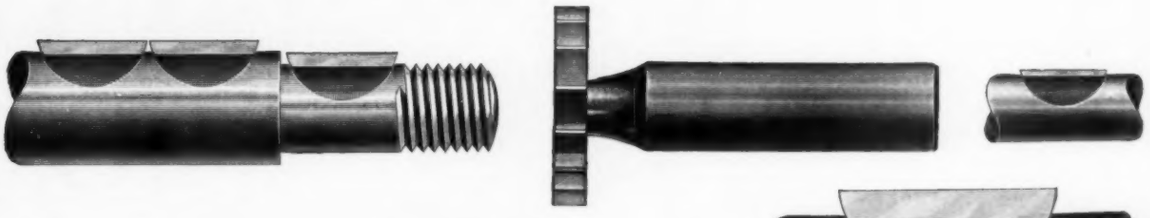

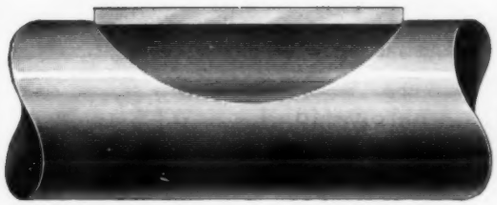

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Brown & Sharpe Mfg. Co., Providence, R. I.
Davis Mach. Co., W. P., Rochester, N. Y.
Hurlbut-Rogers Mach. Co., South Sudbury, Mass.
Newton Mach. Tool Wks., Philadelphia, Pa.
Nutter, Barnes & Co., Boston, Mass.
Pratt & Whitney Co., Hartford, Conn.
Vandyck Churchill Co., New York.

Cutting-off Tools
Armstrong Bros. Tool Co., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn.
Fitchburg Machine Works, Fitchburg, Mass.
O. K. Tool Holder Co., Shelton, Conn.
Pratt & Whitney Co., Hartford, Conn.

Dies, Sheet Metal
American Tube & Stamping Co., Bridgeport, Conn.
Bliss Co., E. W., Brooklyn, N. Y.
Niagara Mach. & Tool Wks., Buffalo, N. Y.

Dies, Threading, Opening
Errington, F. A., New York.
Geometric Tool Co., New Haven, Conn.
Jones & Lamson Mch. Co., Springfield, Vt.
Pratt & Whitney Co., Hartford, Conn.
Swaine Co., Fred J., St. Louis, Mo.

Drafting Machines
Universal Drafting Mach. Co., Cleveland, O.

Drawing Boards and Tables
Keuffel & Esser Co., New York.

Drawing Materials
Keuffel & Esser Co., New York.

Drilling Machines, Bench
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Boynton & Plummer, Worcester, Mass.
Pratt & Whitney Co., Hartford, Conn.

Drilling Machines, Boiler
American Tool Wks. Co., Cin., O.
Aurora Tool Works, Aurora, Ind.
Bickford Drill & Tool Co., Cincinnati, O.
Boynton & Plummer, Worcester, Mass.
Dallett Co., Thos. H., Phila., Pa.
Niles-Bement-Pond Co., New York.

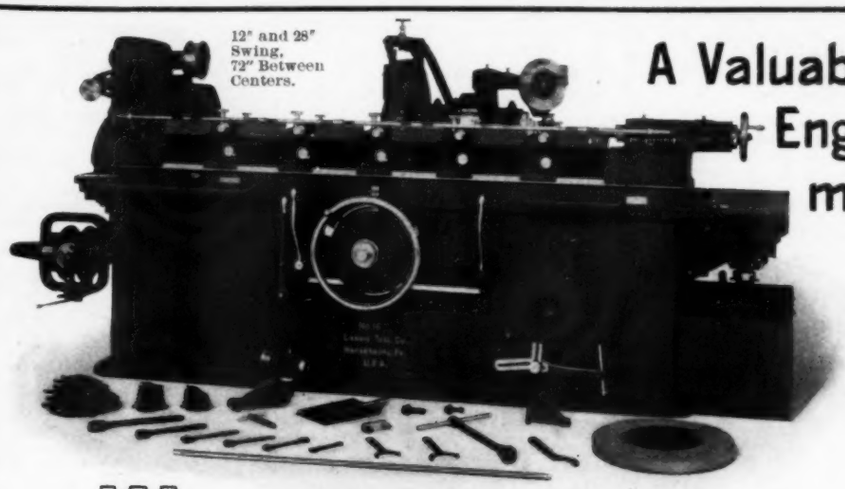
Drilling Machines, Multiple Spindle
American Tool Wks. Co., Cin., O.
Baker Bros., Toledo, O.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Baush Mach. Tool Co., Springfield, Mass.
Bickford Drill & Tool Co., Cincinnati, O.
Dallett Co., Thos. H., Phila., Pa.
Fenn-Sadler Mach. Co., Hartford, Conn.
Foote, Burt & Co., Cleveland, O.
Fosdick Mach. Tool Co., Cin., O.
Garvin Mach. Co., New York.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
McCabe, J. J., New York.
Newton Mach. Tool Works, Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.

Drilling Machines, Portable
Coates Clipper Mfg. Co., Worcester, Mass.
Dallett Co., Thos. H., Phila., Pa.
Hisey-Wolf Mch. Co., Cincin., O.
Niles-Bement-Pond Co., New York.

Drilling Machines, Radial
American Tool Wks. Co., Cin., O.
Baush Mach. Tool Co., Springfield, Mass.
Bickford Drill & Tool Co., Cincinnati, O.
Dreses Mach. Tool Co., Cin., O.
Fairbanks Co., New York.
Fitchburg Machine Works, Fitchburg, Mass.
Fosdick Mach. Tool Co., Cin., O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hill, Clarke & Co., Boston, Mass.
McCabe, J. J., New York.
Mueller Mach. Tool Co., Cin., O.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Ridgway Mach. Tool Co., Ridgway, Pa.
Vandyck Churchill Co., New York.

Drilling Machines, Turret
Niles-Bement-Pond Co., New York.

Drilling Machines, Upright
American Tool Wks. Co., Cin., O.
Aurora Tool Works, Aurora, Ind.
Baker Bros., Toledo, O.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Bertram & Sons Co., Ltd., John, Dundas, Ont., Canada.
Boynton & Plummer, Worcester, Mass.
Cincinnati Mach. Tool Co., Cincinnati, O.



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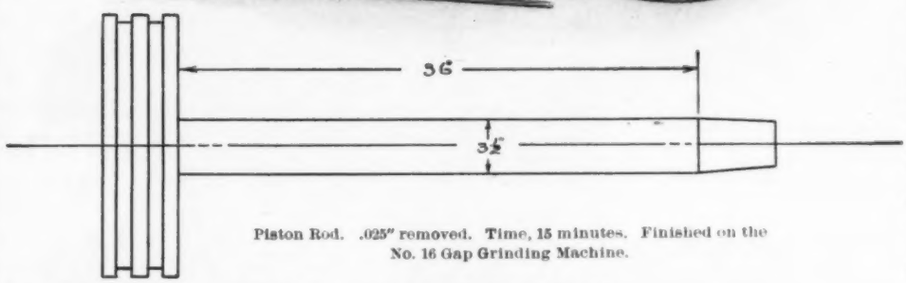

Piston Rod. .025" removed. Time, 15 minutes. Finished on the No. 16 Gap Grinding Machine.

LANDIS TOOL COMPANY, Waynesboro, Pa., U. S. A.

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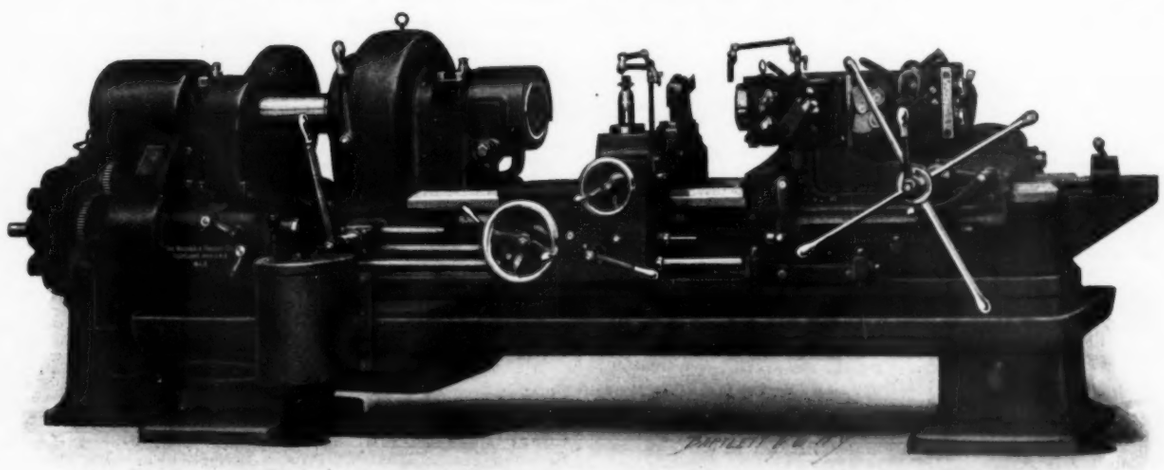

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Dwight Slate Machine Co., Hartford, Conn.
Fairbanks Co., New York.
Fenn-Sadler Mach. Co., Hartford, Conn.
Fosdick Mach. Tool Co., Cincinnati, O.
Gould & Eberhardt, Newark, N. J.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Henry & Wright Mfg. Co., Hartford, Conn.
Hill, Clarke & Co., Boston, Mass.
Hoefer Mfg. Co., Freeport, Ill.
McCabe, J. J., New York.
Marshal & Huschart Mchry. Co., Chicago, Ill.
Mechanics Machine Co., Rockford, Ill.
New Haven Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Sibley Machine Tool Co., South Bend, Ind.
Vandyck Churchill Co., New York.
Whitcomb-Blaisdell Machine Tool Co., Worcester, Mass.
Whitney Mfg. Co., Hartford, Conn.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Drills, Center
Pratt & Whitney Co., Hartford, Conn.
Slocomb Co., J. T., Providence, R. I.
Standard Tool Co., Cleveland, O.

Drills, Pneumatic
Cleveland Pneu. Tool Co., Cleveland, O.
General Pneu. Tool Co., Montour Falls, N. Y.
Ingersoll-Sergeant Drill Co., New York.
Niles-Bement-Pond Co., New York.
Rand Drill Co., New York.

Drills, Hand
Dallett Co., Thos. H., Phila., Pa.
Hisey-Wolf Mach. Co., Cincin., O.
Niles-Bement-Pond Co., New York.

Drills, Rail
Foote, Burt & Co., Cleveland, O.
Niles-Bement-Pond Co., New York.

Drills, Ratchet
Billings & Spencer Co., Hartford, Conn.
Parker Co., Chas., Meriden, Conn.
Pratt & Whitney Co., Hartford, Conn.
Standard Tool Co., Cleveland, O.

Drying Apparatus
Sturtevant Co., B. F., Hyde Park, Mass.

Dust Collectors
Allington & Curtis Mfg. Co., The, Saginaw, Mich.

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C & C Electric Co., New York.
Crocker-Wheeler Co., Ampere, N. J.
Eck Dynamo & Motor Works, Belleville, N. J.
Electro Dynamic Co., Bayonne, N. J.
General Electric Co., New York.
Jantz & Leist Elec. Co., Cin., O.
Northern Elec. Mfg. Co., Madison, Wis.
Ridgway Dynamo & Engine Co., Ridgway, Pa.
Roth Bros. & Co., Chicago, Ill.
Sprague Elec. Co., New York.
Stanley G. I. Elec. Mfg. Co., Pittsfield, Mass.
Sturtevant Co., B. F., Hyde Park, Mass.
Triumph Elec. Co., Cincin., O.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

Electrical Supplies
Burke Electric Co., Erie, Pa.
Clark, Jr., & Co., Jas., Louisville, Ky.
Cutler-Hammer Clutch Co., Milwaukee, Wis.
Electro Dynamic Co., Bayonne, N. J.
General Elec. Co., New York.
Northern Elec. Mfg. Co., Madison, Wis.
Roth Bros. & Co., Chicago, Ill.
Stanley G. I. Elec. Mfg. Co., Pittsfield, Mass.

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Street Bros. Machine Co., Chattanooga, Tenn.
Triumph Elec. Co., Cincinnati, O.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

Electrically Driven Tools and Machinery
American Tool Wks. Co., Cin., O.
Clark, Jr., & Co., Jas., Louisville, Ky.
Crescent Forgings Co., Oakmont, Pa.
Hisey-Wolf Mach. Co., Cincin., O.

Elevators
Albro-Clem Elevator Co., Philadelphia, Pa.
Curtis & Co. Mfg. Co., St. Louis, Mo.
Morse, Williams & Co., Phila., Pa.

Emery Wheels
See Grinding Wheels.

Emery Wheel Dressers
Desmond-Stephan Mfg. Co., Urbana, O.
Heald Machine Co., Worcester, Mass.
International Specialty Co., Detroit, Mich.
Standard Tool Co., Cleveland, O.

Enclosures, Tool-room
Merritt & Co., Philadelphia, Pa.

Engineers, Consulting
McGlehan & Co., C. H., New York.

Engineers, Electrical
Crocker-Wheeler Co., Ampere, N. J.

Engines, Automobile
Franklin Mfg. Co., Syracuse, N. Y.
Olds Gasoline Engine Works, Lansing, Mich.
Raser Gas Engine Works, Ashtabula, O.
Reeves Pulley Co., Columbus, O.

Engines, Gas and Gasoline
Brown-Cochran Co., Lorain, O.
Columbus Mach. Co., Columbus, O.
Foos Gas Engine Co., Springfield, Ohio.
Jacobson Mach. & Mfg. Co., Warren, Pa.
Mietz, August, New York.
New Era Gas Engine Co., Dayton, Ohio.
Olds Gasoline Engine Wks., Lansing, Mich.
Struthers-Wells Co., Warren, Pa.

Engines, Oil
Mietz, August, New York.

Engines, Steam
Buffalo Forge Co., Buffalo, N. Y.
Rand Drill Co., New York.
Ridgway Dynamo & Engine Co., Ridgway, Pa.
Struthers-Wells Co., Warren, Pa.
Sturtevant Co., B. F., Hyde Park, Mass.

Engravers
Binner-Wells Co., Chicago, Ill.

Engraving Machinery
Gorton Mach. Co., Geo., Racine, Wis.

Exhaust Heads
Sturtevant Co., B. F., Hyde Park, Mass.

Exhibition, Machinery
Philadelphia Bourse, Phila., Pa.

Fans, Electric
General Electric Co., New York.
Northern Elec. Mfg. Co., Madison, Wis.
Sprague Elec. Co., New York.
Sturtevant Co., B. F., Hyde Park, Mass.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Fans, Exhaust
Allington & Curtis Mfg. Co., The, Saginaw, Mich.
Sturtevant Co., B. F., Hyde Park, Mass.

Files and Rasps
Barnett Co., G. & H., Phila., Pa.
Hammacher, Schlemmer & Co., New York.
Nicholson File Co., Prov., R. I.
Reichhelm & Co., E. P., New York.

Filing Cabinets
Lundstrom Mfg. Co., C. J., Little Falls, N. Y.

Filing Machines
Henry & Wright Mfg. Co., Hartford, Conn.

Filler, Iron
Clark Cast Steel Cement Co., Shelton, Conn.

Flexible Shafts
Chicago Flexible Shaft Co., Chicago, Ill.
Coates Clipper Mfg. Co., Worcester, Mass.

Forges
Boynton & Plummer, Worcester, Mass.
Buffalo Forge Co., Buffalo, N. Y.
Ingersoll-Sergeant Drill Co., New York.
Miner & Peck Mfg. Co., New York.
Sturtevant Co., B. F., Hyde Park, Mass.

Forgings, Drop
Billings & Spencer Co., Hartford, Conn.
Crescent Forgings Co., Oakmont, Pa.
Williams & Co., J. H., Brooklyn, N. Y.
Wyman & Gordon, Worcester, Mass.

Forgings, Hydraulic
Wyman & Gordon, Worcester, Mass.

Forgings, Steel
Baldwin Steel Co., New York.
Crescent Forgings Co., Oakmont, Pa.
Erie Forge Co., Erie, Pa.
Heppenstall Forge & Knife Co., Pittsburg, Pa.
Tindel-Morris Co., Eddystone, Pa.
Wyman & Gordon, Worcester, Mass.

Forming Machines
Hartford Mch. Screw Co., Hartford, Conn.

Foundry Furnishings
Obermayer Co., S., Cincinnati, O.
Paxson Co., J. W., Phila., Pa.
Sturtevant Co., B. F., Hyde Park, Mass.

Fuel Economizers
Sturtevant Co., B. F., Boston, Mass.

Furnaces, Annealing and Tempering
American Gas Furnace Co., New York.

Furnaces, Enameling
American Gas Furnace Co., New York.

Furnaces, Gas
Am. Gas Furnace Co., N. Y. City.
Chicago Fexible Shaft Co., Chicago, Ill.
Westmacott Co., J. M., Providence, R. I.

Furnaces, Melting
American Gas Furnace Co., New York.

Furniture, Machine Shop
New Britain Mach. Co., New Britain, Conn.

Gas Blowers and Exhausters
Sturtevant Co., B. F., Boston, Mass.

Gauges, Recording
Bristol Co., Waterbury, Conn.

Gauges, Standard
Brown & Sharpe Mfg. Co., Providence, R. I.
Henry & Wright Mfg. Co., Hartford, Conn.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rogers, John M., Boat, Gauge & Drill Works, Gloucester City, N. J.
Slocomb Co., J. T., Prov., R. I.
Starrett Co., L. S., Athol, Mass.

Gauges, Steam
Lunkenheimer Co., Cincinnati, O.

Gear Cutting Machinery
Adams Co., Dubuque, Iowa.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Bickford Drill & Tool Co., Cin., O.
Brown & Sharpe Mfg. Co., Providence, R. I.
Clough, R. M., Tolland, Conn.
Dwight Slate Mach. Co., Hartford, Conn.
Fellows Gear Shaper Co., Springfield, Vt.
Gleason Works, Rochester, N. Y.
Gould & Eberhardt, Newark, N. J.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Whiton Machine Co., D. E., New London, Conn.

Gear Testing Machinery
Gisholt Mach. Co., Madison, Wis.

Gears, Cut
Bilgram, Hugo, Philadelphia, Pa.
Boston Gear Wks., Boston, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Caldwell & Son Co., H. W., Chicago, Ill.
Cresson Co., Geo. V., Phila., Pa.
Davis, Rodney, Philadelphia, Pa.
Earle Gear & Mach. Co., Philadelphia, Pa.
Eberhardt Bros. Mach. Co., Newark, N. J.
Fawcus Mch. Co., Pittsburg, Pa.
Fellows Gear Shaper Co., Springfield, Vt.
Gleason Works, Rochester, N. Y.
Grant Gear Works, Boston, Mass.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Horsburgh & Scott Co., The, Cleveland, O.
Massey Mach. Co., Watertown, N. Y.
New Process Raw Hide Co., Syracuse, N. Y.
Nuttall Co., R. D., Pittsburg, Pa.
Patterson, Gottfried & Hunter, Ltd., New York.
Philadelphia Gear Wks., Philadelphia, Pa.
Sawyer Gear Wks., Cleveland, O.
Simonds Mfg. Co., Pittsburg, Pa.
Syracuse Raw Hide Co., Syracuse, N. Y.
Taylor-Wilson Mfg. Co., Allegheny, Pa.

Gears, Molded
Caldwell & Son Co., H. W., Chicago, Ill.
Farrel Fdry. & Mach. Co., Ansonia, Conn.
Franklin Mfg. Co., Syracuse, N. Y.
Greenwald Co., I. & E., Cincin., O.
Taylor-Wilson Mfg. Co., Allegheny, Pa.

Gears, Rawhide
Boston Gear Wks., Boston, Mass.
Chicago Raw Hide Mfg. Co., Chicago, Ill.
Earle Gear & Mach. Co., Philadelphia, Pa.
Fawcus Mch. Co., Pittsburg, Pa.
Gould & Eberhardt, Newark, N. J.
Horsburgh & Scott Co., Cleveland, Ohio.
New Process Raw Hide Co., Syracuse, N. Y.
Nuttall Co., R. D., Pittsburg, Pa.
Syracuse Raw Hide Co., Syracuse, N. Y.

Gears, Worm
Albro-Clem Elevator Co., Philadelphia, Pa.
Boston Gear Wks., Boston, Mass.
Fawcus Mch. Co., Pittsburg, Pa.
Gould & Eberhardt, Newark, N. J.
Grant Gear Works, Boston, Mass.
Morse, Williams & Co., Phila., Pa.
Nuttall Co., R. D., Pittsburg, Pa.
Philadelphia Gear Works, Philadelphia, Pa.
Simonds Mfg. Co., Pittsburg, Pa.
Taylor-Wilson Mfg. Co., Allegheny, Pa.

Generating Sets
Burke Electric Co., Erie, Pa.
Sturtevant Co., B. F., Boston, Mass.

Generators, Gas
American Gas Furnace Co., New York.

Graphite
Dixon Crucible Co., Jos., Jersey City, N. J.
Obermayer Co., S., Cincinnati, O.

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If You Have A Lot of Gears

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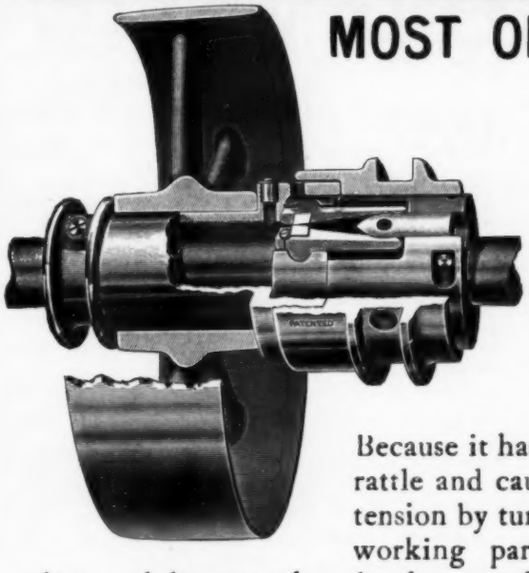

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Mueller Mch. Tool Co., Cin., O.
Niles-Bement-Pond Co., New York.

Grinders, Cock
Windsor Mach. Co., Windsor, Vt.

Grinders, Cutter
Automatic Mach. Co., Greenfield, Mass.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati, O.
Garvin Machine Co., New York.
Gould & Eberhardt, Newark, N. J.
Greenfield Mach. Co., Greenfield, Mass.
Heald Mach. Co., Worcester, Mass.
Hisey-Wolf Mach. Co., Cincin., O.
Niles-Bement-Pond Co., New York.
Norton Emery Wheel Co., Worcester, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rivett-Dock Co., Boston, Mass.

Grinders, Disk
Besly & Co., Chas. H., Chicago, Ill.
Diamond Mach. Co., Provi., R. I.
Heald Machine Co., Worcester, Mass.
Iroquois Mach. Co., New York.
Ransom Mfg. Co., Oshkosh, Wis.
Rowbottom Machine Co., Waterbury, Conn.

Grinders, Drill
Heald Mch. Co., Worcester, Mass.
Niles-Bement-Pond Co., New York.
Standard Tool Co., Cleveland, O.
Wilmarth & Morman Co., Grand Rapids, Mich.

Grinders, Portable
Heald Machine Co., Worcester, Mass.
Hisey-Wolf Mach. Co., Cincin., O.

Grinders, Tool
Armstrong Bros. Tool Co., Chicago, Ill.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Brown & Sharpe Mfg. Co., Providence, R. I.
Diamond Mach. Co., Prov., R. I.
Gisholt Mach. Co., Madison, Wis.
Gould & Eberhardt, Newark, N. J.
Hisey-Wolf Mach. Co., Cincin., O.
Landis Tool Co., Waynesboro, Pa.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Niles-Bement-Pond Co., New York.
Ransom Mfg. Co., Oshkosh, Wis.
Safety Emery Wheel Co., Springfield, O.
Standard Tool Co., Cleveland, O.
Vandyck Churchill Co., New York.
Walker & Co., O. S., Worcester, Mass.
Whitney Mfg. Co., Hartford, Ct.

Grinding and Polishing Machines
Besly & Co., Chas. H., Chicago, Ill.
Blount Co., J. G., Everett, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Builders' Iron Foundry, Providence, R. I.
Coates Clipper Mfg. Co., Worcester, Mass.
Diamond Mach. Co., Prov., R. I.
Fairbanks Co., New York.
Gilmore Electric Co., South Boston, Mass.
Goodell-Pratt Co., Greenfield, Mass.
Greenfield Mach. Co., Greenfield, Mass.
Hill, Clarke & Co., Boston, Mass.
Iroquois Mach. Co., New York.
Landis Tool Co., Waynesboro, Pa.
Marshall & Huschart Mchry. Co., Chicago, Ill.
Niles-Bement-Pond Co., New York.
Northern Elec. Mfg. Co., Madison, Wis.
Norton Emery Wheel Co., Worcester, Mass.
Norton Grinding Co., Worcester, Mass.
Pattison Machinery Co., W. M., Cleveland, O.
Prentiss Tool & Supply Co., New York.
Ransom Mfg. Co., Oshkosh, Wis.
Rivett-Dock Co., Boston, Mass.

Grinding and Polishing Machines—*Continued*
Safety Emery Wheel Co., Springfield, O.
Standard Tool Co., Cleveland, O.
Vandyck Churchill Co., New York.
Vitrified Wheel Co., Westfield, Mass.
Walker & Co., O. S., Worcester, Mass.
Webster & Perks Tool Co., Springfield, O.
Wilmarth & Morman Co., Grand Rapids, Mich.

Grinding Wheels
Abrasive Material Co., Philadelphia, Pa.
Adams Co., Dubuque, Iowa.
Builders Iron Foundry, Providence, R. I.
Carborundum Co., Niagara Falls, N. Y.
Diamond Mach. Co., Prov., R. I.
Hampden Cor. Wheel Co., Brightwood, Mass.
National Corundum Wheel Co., Buffalo, N. Y.
Niles-Bement-Pond Co., New York.
Norton Emery Wheel Co., Worcester, Mass.
Safety Emery Wheel Co., Springfield, O.
Superior Corundum Wheel Co., Waltham, Mass.
Vitrified Wheel Co., Westfield, Mass.
Whitney Mfg. Co., Hartford, Ct.

Grindstones and Frames
Niles-Bement-Pond Co., New York.

Gun Barrel Machinery
Diamond Mach. Co., Prov., R. I.
Pratt & Whitney Co., Hartford, Conn.

Hack Saw Blades and Frames
Goodell-Pratt Co., Greenfield, Mass.
Hammacher, Schlemmer & Co., New York.
Massachusetts Saw Wks., Chicopee, Mass.
Millers Falls Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Starrett Co., L. S., Athol, Mass.
West Haven Mfg. Co., New Haven, Conn.

Hack Saws, Power
Fairbanks Co., New Haven.
Hoefer Mfg. Co., Freeport, Ill.
Millers Falls Co., New York.
Niles-Bement-Pond Co., New York.
West Haven Mfg. Co., New Haven, Conn.

Hammers, Drop
Billings & Spencer Co., Hartford, Conn.
Bliss Co., E. W., Brooklyn, N. Y.
Chambersburg Engineering Co., Chambersburg, Pa.
Gould & Eberhardt, Newark, N. J.
Miner & Peck Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
Waterbury Farrel Fdry. & Mach. Co., Waterbury, Conn.

Hammers, Electric
Northern Elec. Mfg. Co., Madison, Wis.

Hammers, Pneumatic
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Dallett Co., Thos. H., Phila., Pa.
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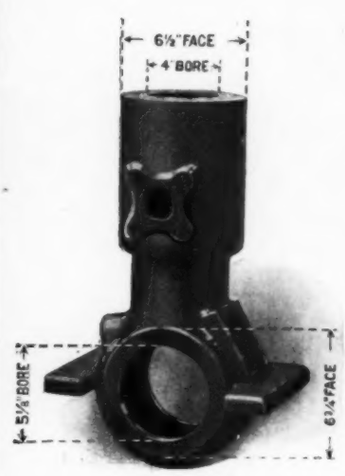

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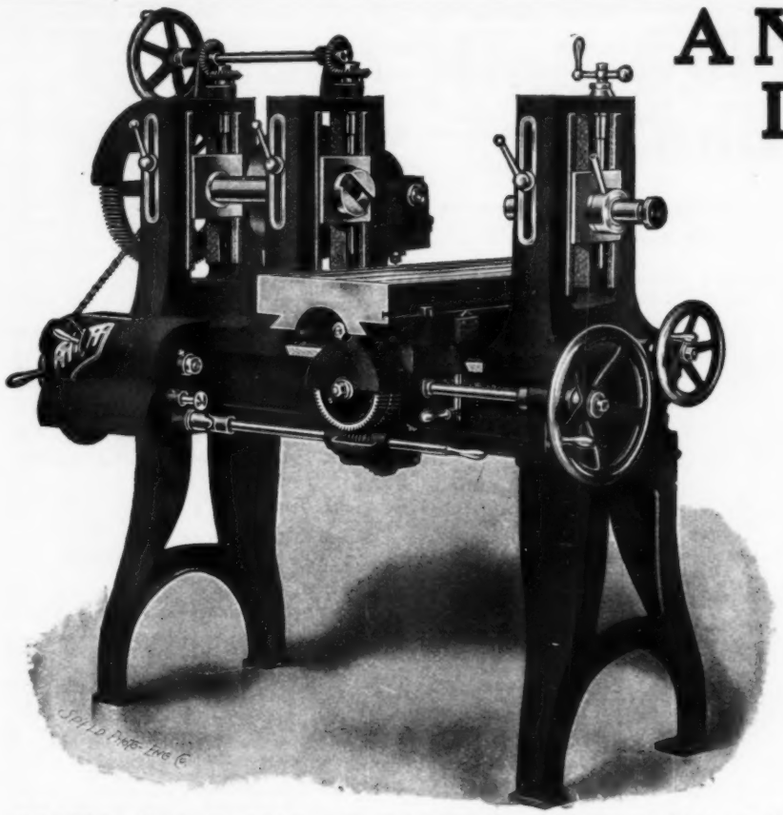

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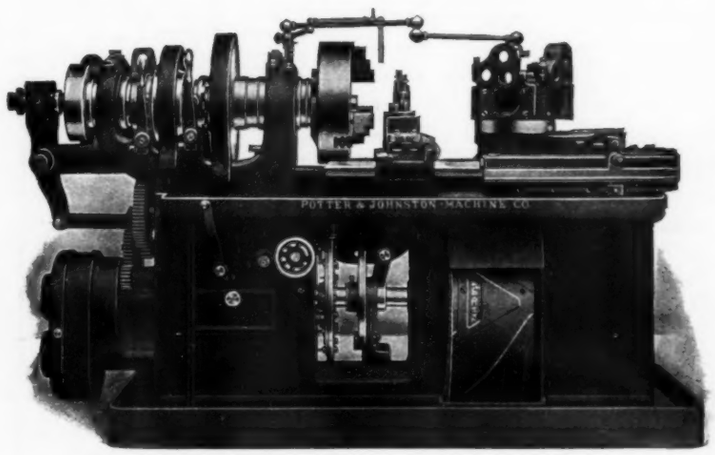

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Taylor-Wilson Mfg. Co., Allegheny, Pa.
Wilmarth & Morman Co., Grand Rapids, Mich.
Wood's Sons, T. B., Chambersburg, Pa.

Pulley Turning and Boring Machines
American Tool Wks. Co., Cin., O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
New Haven Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.

Pumps, Hydraulic
Watson-Stillman Co., New York.

Punches, Centering
Brown & Sharpe Mfg. Co., Providence, R. I.
Hammacher, Schlemmer & Co., New York.

Punches, Hydraulic
Bethlehem Fdry. & Mach. Co., So. Bethlehem, Pa.
Niles-Bement-Pond Co., New York.
Watson-Stillman Co., New York.

Punches, Power
Bertram & Sons Co., Ltd., John, Dundas, Ont., Canada.
Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.
Bliss Co., E. W., Brooklyn, N. Y.
Hilles & Jones Co., Wilmington, Del.
Long & Allstatter Co., Hamilton, Ohio.
Niagara Mach. Tool Wks., Buffalo, N. Y.
Niles-Bement-Pond Co., New York.
Vandyck Churchill Co., New York.

Rack Cutting Machines
Adams Co., Dubuque, Iowa.
Fellows Gear Shaper Co., Springfield, Vt.
Gould & Eberhardt, Newark, N. J.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.

Racks, Cut
Boston Gear Wks., Boston, Mass.
Fellows Gear Shaper Co., Springfield, Vt.
Gould & Eberhardt, Newark, N. J.
Nuttall Co., R. D., Pittsburg, Pa.
Simonds Mfg. Co., Pittsburg, Pa.
Standard Gauge Steel Co., Beaver Falls, Pa.
Taylor-Wilson Mfg. Co., Allegheny, Pa.

Racks, Tool
Massey Mach. Co., Watertown, N. Y.
New Britain Mch. Co., New Britain, Conn.

Radiators, Japanning Oven
American Gas Furnace Co., New York.

Reamers
Boker & Co., Hermann, New York.
Cleveland Twist Drill Co., Cleveland, O.
Clough, R. M., Tolland, Conn.
Gisholt Mach. Co., Madison, Wis.
Hammacher, Schlemmer & Co., New York.
Lapointe Mach. Tool Co., Boston, Mass.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
New Process Twist Drill Co., Taunton, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.
Schellenbach & Radcliffe, Cin., O.
Standard Tool Co., Cleveland, O.
Wells Bros. Co., Greenfield, Mass.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Regulators, Voltage
Gilmore Electric Co., South Boston, Mass.

Rheostats
Cutler-Hammer Clutch Co., Milwaukee, Wis.
General Elec. Co., New York.

Rings, Chuck and Gear
Standard Welding Co., Cleve., O.

Riveters, Hydraulic
Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.
Chambersburg Engineering Co., Chambersburg, Pa.
Niles-Bement-Pond Co., New York.
Watson-Stillman Co., New York.

Riveters, Pneumatic
Cleveland Pneumatic Tool Co., Cleveland, O.
Dallett Co., Thos. H., Phila., Pa.
General Pneumatic Tool Co., Montour Falls, N. Y.
Ingersoll-Sergeant Drill Co., New York.
Niles-Bement-Pond Co., New York.
Rand Drill Co., New York.

Riveters, Steam
Chambersburg Engineering Co., Chambersburg, Pa.

Riveting Machines
Bethlehem Foundry & Mach. Co., So. Bethlehem, Pa.
Long & Allstatter Co., Hamilton, Ohio.
Niles-Bement-Pond Co., New York.

Roller and Ball Bearings
Auburn Ball Bearing Co., Rochester, N. Y.
Ball Bearing Co., Phila., Pa.
Boston Gear Wks., Boston, Mass.
Hess-Bright Mfg. Co., Phila., Pa.
Hyatt Roller Bearing Co., Harrison, N. J.
Standard Roller Bearing Co., Philadelphia, Pa.

Rolling Mill Machinery
Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.
Dill Machine Works, T. C., Philadelphia, Pa.
Hilles & Jones Co., Wilmington, Del.
Niles-Bement-Pond Co., New York.
Waterbury Farrel Fdry. & Mach. Co., Waterbury, Conn.

Rules, Steel
Hammacher, Schlemmer & Co., New York.
Lucas, J. L., Bridgeport, Conn.
Sawyer Tool Mfg. Co., Fitchburg, Mass.
Slocomb Co., J. T., Provi., R. I.
Starrett Co., L. S., Athol, Mass.

Safety Valves, Pop
Crane Co., Chicago, Ill.
Lunkenheimer Co, Cincinnati, O.

Sand Blast Apparatus
Drucklieb, C., New York.
Paxson Co., J. W., Philadel., Pa.

Sand Mixing and Sifting Machines
Gould & Eberhardt, Newark, N. J.
Obermayer Co., S., Cincin., O.

Saw Sharpening Machines
Nutter, Barnes & Co., Boston, Mass.

Sawing Machines, Metal
Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.
Cochrane-Bly Co., Rochester, N. Y.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Nutter, Barnes & Co., Boston, Mass.
Tabor Mfg. Co., Phila., Pa.
Tindel-Morris Co., Eddystone, Pa.
Vandyck Churchill Co., New York.
West Haven Mfg. Co., New Haven, Conn.

Sawing Machines, Wood
Colburn Mach. Tool Co., Franklin, Pa.
Seneca Falls Mfg. Co., Seneca Falls, N. Y.

Schools, Correspondence
American School of Correspondence, Chicago, Ill.
Columbia Correspondence Schools, Philadelphia, Pa.
International Correspon. Schools, Scranton, Pa.

Schools, Technical
Manhattan Automobile School, New York.
Pratt Institute, Brooklyn, N. Y.

Screw Machines, Automatic
Automatic Mach. Co., Greenfield, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Automatic Mach. Co., Cleveland, O.
Dreses Mach. Tool Co., Cincin., O.
Hartford Mach. Screw Co., Hartford, Conn.
National-Acme Mfg. Co., Cleveland, O.
Pratt & Whitney Co., Hartford, Conn.
Windsor Mach. Co., Windsor, Vt.

Screw Machines, Hand
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Automatic Mach. Co., Cleveland, O.
Draper Mach. Tool Co., Worcester, Mass.
Garvin Mach. Co., New York.
Hartford Mach. Screw Co., Hartford, Conn.
Jones & Lamson Mch. Co., Springfield, Vt.
Potter & Johnston Mach. Co., Pawtucket, R. I.
Pratt & Whitney Co., Hartford, Conn.
Warner & Swasey Co., Cleveland, Ohio.
Windsor Mach. Co., Windsor, Vt.

Screw Machinery, Wood and Lag
Baker Bros., Toledo, O.
Cook Co., Asa S., Hartford, Ct.
Hammacher, Schlemmer & Co., New York.

Screw Plates
Besly & Co., Chas. H., Chicago, Ill.
Card Mfg. Co., S. W., Mansfield, Mass.
Carpenter Tap & Die Co., J. M., Pawtucket, R. I.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Wells Bros. Co., Greenfield, Mass.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Screws, Machine
Cincinnati Screw & Tap Co., Cincinnati, O.
Cleveland Cap Screw Co., Cleveland, O.
Hammacher, Schlemmer & Co., New York.
Hartford Mach. Screw Co., Hartford, Conn.
National-Acme Mfg. Co., Cleveland, O.
Worcester Mach. Screw Co., Worcester, Mass.

Second Hand Machinery
American Tool Wks. Co., Cin., O.
Baird Mchry. Co., Pittsburg, Pa.
Fairbanks Co., New York.
Garvin Mch. Co., New York.
Hamilton Mach. Tool Co., Hamilton, O.
Hill, Clarke & Co., Boston, Mass.
Ide & Son, A. L., Springfield, Ill.
McCabe, J. J., New York.
McDowell, Stocker & Co., Chicago, Ill.
Marshall & Huschart Mchry. Co., Chicago, Ill.
Motch & Merryweather Co., Cleveland, O.
New Haven Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
Pattison Mchry. Co., W. M., Cleveland, O.
Prentiss Tool & Supply Co., New York.
Toomey, Frank, Philadelphia, Pa.
Wormer Machy. Co., C. C., Detroit, Mich.

Separators, Magnetic
Cresson Co., Geo. V., Phila., Pa.

Separators, Oil and Steam
American Tool & Mach. Co., Boston, Mass.
Nicholson & Co., W. H., Wilkesbarre, Pa.
Oil & Waste Saving Mach. Co., Philadelphia, Pa.

Shafting
Cresson Co., Geo. V., Phila., Pa.
Cumberland Steel Co., Cumberland, Md.
Niles-Bement-Pond Co., New York.
Union Drawn Steel Co., Beaver Falls, Pa.
Wood's Sons, T. B., Chambersburg, Pa.

Shapers
American Tool Wks. Co., Cin., O.
Bertram & Sons Co., Ltd., John, Dundas, Ont., Canada.
Blount Co., J. G., Everett, Mass.
Boynton & Plummer, Worcester, Mass.
Cincinnati Shaper Co., Cincin., O.
Fairbanks Co., New York.
Fitchburg Machine Works, Fitchburg, Mass.
Garvin Mach. Co., New York.
Gould & Eberhardt, Newark, N. J.
Hendey Mch. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
Kelly Mach. Co., R. A., Xenia, O.
Niles-Bement-Pond Co., New York.
Potter & Johnston Mach. Co., Pawtucket, R. I.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Suppy Co., New York.
Smith & Mills, Cincinnati, O.
Springfield Mch. Tool Co., Springfield, O.
Vandyck Churchill Co., New York.

Shears, Power
Bertsch & Co., Cambridge City, Ind.
Bethlehem Fdry. & Mch. Co., So. Bethlehem, Pa.
Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.
Bliss Co., E. W., Brooklyn, N. Y.
Hilles & Jones Co., Wilmington, Del.
Long & Allstatter Co., Hamilton, Ohio.
Niagara Mach. & Tool Wks., Buffalo, N. Y.
Niles-Bement-Pond Co., New York.
Phillips & Sons Co., F. R., Philadelphia, Pa.
Vandyck Churchill Co., New York.

Shears, Rotary
Bethlehem Fdry. & Mch. Co., So. Bethlehem, Pa.
Detrick & Harvey Mach. Co., Baltimore, Md.

Shelving, Shop
New Britain Mch. Co., New Britain, Conn.

Slotters
Baker Bros., Toledo, O.
Dill Slotter People, Phila., Pa.

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American Watch Tool Co., Waltham, Mass.
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Newton Mach. Tool Wks., Philadelphia, Pa.
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Bilgram, Hugo, Philadelphia, Pa.
Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.
Blanchard Mach. Co., The, Boston, Mass.
Crescent Forgings Co., Oakmont, Pa.
Dallett Co., Thos. H., Phila., Pa.
Fenn-Sadler Machine Co., Hartford, Conn.
General Mfg. Co., New York.
Hoefer Mfg. Co., Freeport, Ill.
Lucas Mch. Tool Co., Cleveland, Ohio.
Massey Mach. Co., Watertown, N. Y.
Mechanical Accountant Co., Providence, R. I.
Nutter, Barnes & Co., Boston, Mass.
Pratt & Whitney Co., Hartford, Conn.
Simonds Mfg. Co., Pittsburg, Pa.
Waterbury Farrel Fdry. & Mach. Co., Waterbury, Conn.
Whatley, A. H., Providence, R. I.

Speed Changing Countershafts
Cresson Co., Geo. V., Phila., Pa.
Gisholt Mach. Co., Madison, Wis.
Reeves Pulley Co., Columbus, Ind.
Speed Changing Pulley Co., Indianapolis, Ind.

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Baldwin Chain & Mfg. Co., Worcester, Mass.
Boston Gear Wks., Boston, Mass.

Stampings, Sheet Metal
American Tube & Stamping Co., Bridgeport, Conn.

Stampings, Welded
American Tube & Stamping Co., Bridgeport, Conn.
Standard Weding Co., Cleve., O.

Stamps, Steel
Schwerdtle Stamp Co., Bridgeport, Conn.

Steam Specialties
Crane Co., Chicago, Ill.
Jenkins Bros., New York.
Lunkenheimer Co., Cincinnati, O.

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Baldwin Steel Co., New York.
Boker & Co., Hermann, New York.
Firth-Sterling Steel Co., Demmler, Pa.
Kent & Co., Edwin R., Chicago, Ill.
McInnes Steel Co., Corry, Pa.
Morton & Co., B. K., Toronto, Canada.
Union Drawn Steel Co., Beaver Falls, Pa.
Ward & Son, Edgar T., Boston, Mass.

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American Tube & Stamping Co., Bridgeport, Conn.
Union Drawn Steel Co., Beaver Falls, Pa.
Ward & Son, Edgar T., Boston, Mass.

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American Tube & Stamping Co., Bridgeport, Conn.
Baldwin Steel Co., New York.
Boker & Co., Hermann, New York.
Firth-Sterling Steel Co., Demmler, Pa.
Kent & Co., Edwin R., Chicago, Ill.
McInnes Steel Co., Corry, Pa.
Patterson, Gottfried & Hunter, Ltd., New York.
Phillips & Sons Co., F. R., Phila-
Royal Metal Steel Co., New York. delphia, Pa.
Union Drawn Steel Co., Beaver Falls, Pa.
Vickers, Sons & Maxim, Sheffield, England.
Ward & Son, Edgar T., Boston, Mass.

Straightening Machinery
Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.
Fitchburg Machine Works, Fitchburg, Mass.
Hartford Mach. Screw Co., Hartford, Conn.
Springfield Mch. Tool Co., Springfield, O.

Straighteners, Hydraulic
Niles-Bement-Pond Co., New York.
Watson-Stillman Co., New York.

Swaging Machines
Excelsior Needle Co., Torrington, Conn.

Switchboards
C & C Electric Co., New York.
General Electric Co., New York.
Triumph Elec. Co., Cincinnati, O.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Switches
Cutler-Hammer Clutch Co., Milwaukee, Wis.
Stanley Elec. Mfg. Co., Pittsfield, Mass.

Tapes, Measuring
Keuffel & Esser Co., New York.
Starrett Co., L. S., Athol, Mass.

Tap Holders
Errington, F. A., New York.

Tapping Machines and Attachments
American Tool Wks. Co., Cin., O.
Baker Bros., Toledo, O.
Beaman & Smith Co., The, Providence, R. I.
Bickford Drill & Tool Co., Cin., O.
Cincinnati Mach. Tool Co., Cincinnati, O.
Errington, F. A., N. Y. City.
Fosdick Mach. Tool Co., Cin., O.
Garvin Mach. Co., New York.
Geometric Tool Co., New Haven, Conn.
Gould & Eberhardt, Newark, N. J.
Hartford Mach. Screw Co., Hartford, Conn.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Webster & Perks Tool Co., Springfield, O.
Whitney Mfg. Co., Hartford, Ct.

Taps and Dies
Bay State Tap & Die Co., Mansfield, Mass.
Besly & Co., Chas. H., Chicago, Ill.
Card Mfg. Co., S. W., Mansfield, Mass.
Carpenter Tap & Die Co., J. M., Pawtucket, R. I.
Cleveland Twist Drill Co., Cleveland, O.
Geometric Tool Co., New Haven, Conn.
Hammacher, Schlemmer & Co., New York.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Standard Tool Co., Cleveland, O.
Webster & Perks Tool Co., Springfield, O.
Wells Bros. Co., Greenfield, Mass.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Taps, Collapsing
Geometric Tool Co., New Haven, Conn.
Hemming Bros., New Haven, Conn.

Telephones
N. Y. Telephone Co., New York.

Thermit
Goldschmidt Thermit Co., New York.

Thread Cutting Tools
Besly & Co., Chas. H., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn.
Pratt & Whitney Co., Hartford, Conn.
Rivett-Dock Co., Boston, Mass.

Time Recorders
Simplex Time Recorder Co., Gardner, Mass.

Tool Holders
Armstrong Bros. Tool Co., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn.
Hill-Standard Mfg. Co., Anderson, Ind.

Tool Holders—*Continued*
Hoggson & Pettis Mfg. Co., New Haven, Conn.
O. K. Tool Holder Co., Shelton, Conn.
Pratt & Whitney Co., Hartford, Conn.

Tools, Small
See Machinists' Small Tools.

Transformers and Converters
General Elec. Co., New York.
Stanley G. I. Elec. Mfg. Co., Pittsfield, Mass.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Transmission Machinery
American Pulley Co., Phila., Pa.
Caldwell & Son Co., H. W., Chicago, Ill.
Case Mfg. Co., Columbus, O.
Cresson & Co., Geo. V., Philadelphia, Pa.
Eastern Machinery Co., New Haven, Conn.
Link-Belt Engineering Co., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Reeves Pulley Co., Columbus, Ind.
Speed Changing Pulley Co., Indianapolis, Ind.
Wood's Sons, T. B., Chambersburg, Pa.

Traps, Steam
Sturtevant Co., B. F., Hyde Park, Mass.

Trolleys and Tramways
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Link-Belt Engineering Co., Philadelphia, Pa.
Maris Bros., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Yale & Towne Mfg. Co., New York.

Tubing, Steel
Almond Mfg. Co., T. R., Brooklyn, N. Y.
American Tube & Stamping Co., Bridgeport, Conn.

Turret Heads
Almond Mfg. Co., T. R., Brooklyn, N. Y.

Turret Machines
American Tool & Mach. Co., Boston, Mass.
Automatic Mach. Co., Greenfield, Mass.
Bradford Mach. Tool Co., Cincinnati, O.
Brown & Sharpe Mfg. Co., Providence, R. I.
Bullard Mach. Tool Co., Bridgeport, Conn.
Dreses Mach. Tool Co., Cincin., O.
Garvin Mach. Co., New York.
Gisholt Mach. Co., Madison, Wis.
Hill, Clarke & Co., Boston, Mass.
Jones & Lamson Mch. Co., Springfield, Vt.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Lodge & Shipley Mach. Tool Co., Cincinnati, O.
Massey Mach. Co., Watertown, N. Y.
Niles-Bement-Pond Co., New York.
Potter & Johnston Mach. Co., Pawtucket, R. I.
Pratt & Whitney Co., Hartford, Conn.
Springfield Mch. Tool Co., Springfield, O.
Warner & Swasey Co., Cleveland, Ohio.
Windsor Mach. Co., Windsor, Vt.

Twist Drills
Boker & Co., Hermann, New York.
Cleveland Twist Drill Co., Cleveland, O.
Hammacher, Schlemmer & Co., New York.
Morse Twist Drill & M. Co., New Bedford, Mass.
New Process Twist Drill Co., Taunton, Mass.
Niles-Bement-Pond Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Phillips & Sons Co., F. R., Philadelphia, Pa.
Royal Metal Steel Co., New York.
Standard Tool Co., Cleveland, O.
Whitman & Barnes Mfg. Co., Chicago, Ill.

Universal Joints
Baush Mach. Tool Co., Springfield, Mass.
Boston Gear Wks., Boston, Mass.
Gould & Eberhardt, Newark, N. J.
Gray & Prior Mach. Co., Hartford, Conn.
Mutual Machine Co., Hartford, Conn.

Unions, Brass
Lunkenheimer Co., Cincinnati, O.

Valves
See Steam Specialties.

Vises, Drill
Hopkinson Mach. Works, Springfield, Mass.

Vises, Metal Workers'
Hammacher, Schlemmer & Co., New York.
Millers Falls Co., New York.
Parker Co., Chas., Meriden, Conn.
Reed Mfg. Co., Erie, Pa.

Vises, Pipe
Curtis & Curtis Co., Bridgeport, Conn.
Saunders' Sons, D., Yonkers, N. Y.

Vises, Planer and Shaper
American Tool Wks. Co., Cin., O.
Cincinnati Planer Co., Cincin., O.
Hendey Mach. Co., Torrington, Conn.
Niles-Bement-Pond Co., New York.

Vises, Universal Machine
Graham Mfg. Co., Provi., R. I.

Vises, Wood Workers'
Hammacher, Schlemmer & Co., New York.
Parker Co., Chas., Meriden, Conn.
Wyman & Gordon, Worcester, Mass.

Watchmen's Clocks
Simplex Time Recorder Co., Gardner, Mass.

Welding
Goldschmidt Thermit Co., New York.

Welding, Electric
American Tube & Stamping Co., Bridgeport, Conn.
C & C Elec. Co., New York.
Standard Welding Co., Cleveland, Ohio.

Welding Machines
Long & Allstatter Co., Hamilton, Ohio.

Welding Plates
Phillips & Sons Co., F. R., Philadelphia, Pa.

Wire-Drawing Machinery
Iroquois Mach. Co., New York.
Waterbury Farrel Fdry. & Mach. Co., Waterbury, Conn.

Wire-Straightening Machinery
Hoefer Mfg. Co., Freeport, Ill.

Wood Working Machinery
Seneca Falls Mfg. Co., Seneca Falls, N. Y.

Worm Hobbing Machines
Pratt & Whitney Co., Hartford, Conn.

Worm Milling Machines
Cleveland Automatic Mach. Co., Cleveland, O.
Pratt & Whitney Co., Hartford, Conn.

Wrenches, Drop Forged
Billings & Spencer Co., Hartford, Conn.
Williams & Co., J. H., Brooklyn, N. Y.

Wrenches, Machinists'
Bemis & Call Hardware & Tool Co., Springfield, Mass.
Billings & Spencer Co., Hartford, Conn.
Ccs Wrench Co., Worcester, Mass.
Hammacher, Schlemmer & Co., New York.
Whitman & Barnes Mfg. Co., Chicago, Ill.

Wrenches, Pipe
Bemis & Call Hardware & Tool Co., Springfield, Mass.
Bullard Automatic Wrench Co., Providence, R. I.

A Machine-Shop Crank-Press.

EDITORIAL CORRESPONDENCE.

The readers of the AMERICAN MACHINIST will recall a series of articles on machine tools written by Mr. John Richards and published in these columns in 1899. In the fourth article of that series, at page 430, Mr. Richards illustrated a crank-driven mandril press by Bodmer, and a simplified form of the same machine designed by himself in 1885. Of this press he said: "It is hard to realize without experiment the completeness of the operation. It is the same as though the operator was pushing the mandril in or out by hand. He could 'feel' the whole operation, which could be fast or slow, ⅛ or 1-32 inch, at each stroke. There was also the peculiarity of the force being graduated to the work; the less the movement the greater the force. The machines are simple, cheap and durable. Why they are not in use is a problem not easy to answer."

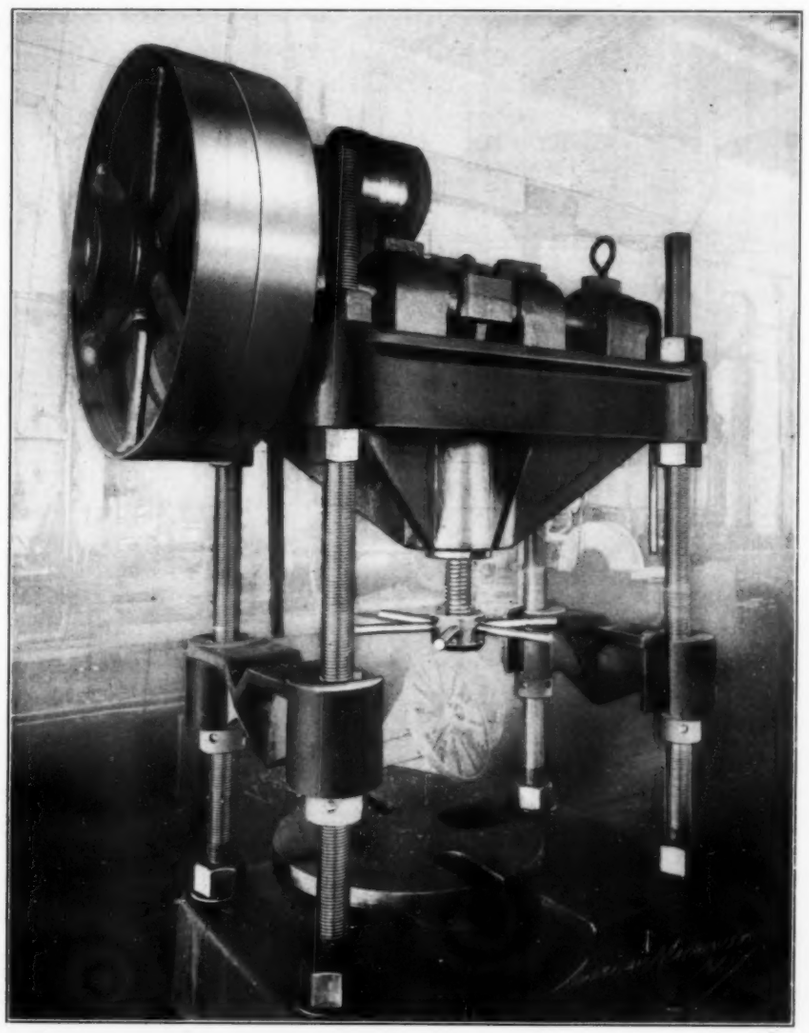


FIG. I. A MACHINE-SHOP CRANK-PRESS.

This machine has been re-invented and re-designed by Mr. William A. Box, superintendent of the Denver Engineering Works, of Denver, Col., and Fig. 1 shows the machine as it stands on the shop floor. The machine is much larger than the one designed by Mr. Richards, being intended as a general substitute for a hydraulic press, but in principle, action and general construction the two machines are identical. I have seldom seen so complete a case of duplication in invention as this. Mr. Box gives the same good word for the press as Mr. Richards, and it is to be hoped that its usefulness and completeness will lead to its resuscitation being permanent and to some exterprising tool builder placing it on the market as a regular product—an action which will be facilitated by the working drawings published herewith through the courtesy of Mr. Box.

The press consists essentially of a framework and plunger which is given a vertical reciprocating motion of ¼ inch by a heavy eccentric shaft carried by the upper crosshead. The lower end of the plunger is threaded internally and has fitted to it a stout screw, which carries radiating spokes for turning it. The head of this screw forms the pressure point by which mandrels, shafts and crank pins are pressed home. With the work in place, the operator starts the press and spins the screw down to contact. The reciprocation of the plunger pushes the work together, the action of the plunger being followed up by the screw until the required pressure is obtained and it is in thus turning the screw that the "feel" of the work is obtained. The screw has considerable length to accommodate various sizes of work, but additional adjustment is obtained by the threaded columns. A circular base plate, with various sizes of openings, provides for work of varying diameter. A use of the press not apparently intended by Mr. Richards is the straightening of rough iron, for which two V-blocks are provided which are so made as to be easily lifted off in case they are in the way when other work is being done, though this seldom happens. The press is particularly convenient in straightening work, as it not only straightens, but tests the piece and finds the high side. This testing is, of course, done by turning the bar in the V's, the end of the pressure screw taking the place of the usual piece of chalk and indicating at once the high side where pressure is to be applied. In use the application of pressure and the turning of the bar alternate, the press showing when its work is done. The bar is put in the press, tested, straightened and re-tested without removal.

When making press fits the pressure applied is, of course, indeterminate, but a little experience overcomes all difficulties and the press is used with great satisfaction. Figuring back to the belt power provided, Mr. Box considers the machine capable of exerting a pressure of about 50 tons.

The detail illustrations are self-explanatory. F. A. H.

Machine-Tool Business in Germany.

Consul-General Guenther, of Frankfort, reports favorable conditions in the machine-tool trade and calls attention to the efforts of the Germans to maintain their present position in the world's markets with their machine-tool products. He writes:

The Association of German Machine Tool Manufacturers has received a report from its executive board which recently convened at Düsseldorf. The report speaks favorably of the condition of the trade. The exports of German machine tools for the first half of 1905 amounted to 16,400 metric tons, exceeding that for the corresponding period of 1904 by 2,800 tons, but in some respects the export trade has become more difficult, owing to the strong

efforts made by foreign competitors. Prices are better, although kept down even in the home market by the pressure from foreign competition. The executive board trusts that a satisfactory treaty will be concluded with the United States, and relies on the German Government to make such stipulations as will safeguard this important branch of German industries. The steadily increasing importation of American machine tools by Germany justifies the demand that the United States lower her tariff barriers so as to afford entry thereinto of German products.—*Consular Trade Reports.*

The Cause of Crystallization.

A discovery that may prove of great importance has been made by Sir Purcell Taylor, Bart. He has discovered that the agencies which cause the formation of crystals are twofold, and that the principles which govern the forms of crystals are also twofold.

The matter would require too much space, and would be altogether too abstruse for us to deal with it here *in extenso;* but, in a word, it may be said that the new discovery entirely controverts the commonly accepted ideas of the formation of crystals.

In the first place, it was supposed that crystals were formed only when liquids were perfectly quiet and at rest; but it has now been discovered that crystals are the result of a rhythmic motion taking place among the ultimate molecules of the substance, and that crystals may be formed under these circumstances in liquids, solids and gases.

This discovery explains the crystallization of metals that takes place in engineering structures, and which frequently results in the breaking of bridges, railway axles and the tunnel and propeller shafts of steamships. In the latter connection, it is curious that Sir Purcell Taylor should have invented, some twenty-five years ago, the built-up crankshaft for steamers, which has almost entirely done away with the constant breakage of crankshafts, and should now have discovered, indirectly, the cause of the continual breakage of the propeller shafting.

The discovery points also to the existence of a fourth state of matter beyond that of gas.

In passing through a large railroad shop one day during the recent hot spell the writer noticed a unique advantage which was being taken of an individual motor-driven machine tool. The motor was mounted above the headstock of a Jones & Lamson turret lathe, and the machine operator had fastened a small fan to the end of the armature shaft, so that a cool breeze was directed upon him while the machine was in operation.—*American Engineer and Railroad Journal.*

The Naval Personnel Act and its Results.

BY J. SNOWDEN BELL.

While much interest has been manifested, both abroad and in the United States, in the operation of that portion of the so-called "Naval Personnel" act which abolished the engineer corps and "amalgamated" the line and the engineer officers of the United States Navy, it has, up to the time that the public mind was shocked by the recent and deplorable disaster on the "Bennington," been confined almost entirely to those who, by professional training and occupation, were, to a greater or less extent, specially and technically informed. The nature and scope, the operation, and the results of this legislation, were not a matter of particular interest to the general public, and the attention paid to them has heretofore been so slight that very few persons either correctly understood them or recognized the extent and gravity of the possibilities which they involved. The Secretary of the Navy has requested a suspension of the public judgment as to the responsibility for the "Bennington" explosion until a thorough investigation of the circumstances connected with it has been made, and this request should be fairly complied with.

It is, however, obvious from the general tone of the press, that the extent to which the conditions resultant upon the enactment of the Naval Personnel act have been factors in this disaster, is a question which is now a plainly defined and an important one, and which must be fully and clearly determined. How far, if at all, it may be considered and publicly passed upon by the Navy Department remains to be seen, and, in the meanwhile, a correct understanding of it cannot act to prejudice the public judgment and should serve to facilitate its correct and intelligent expression.

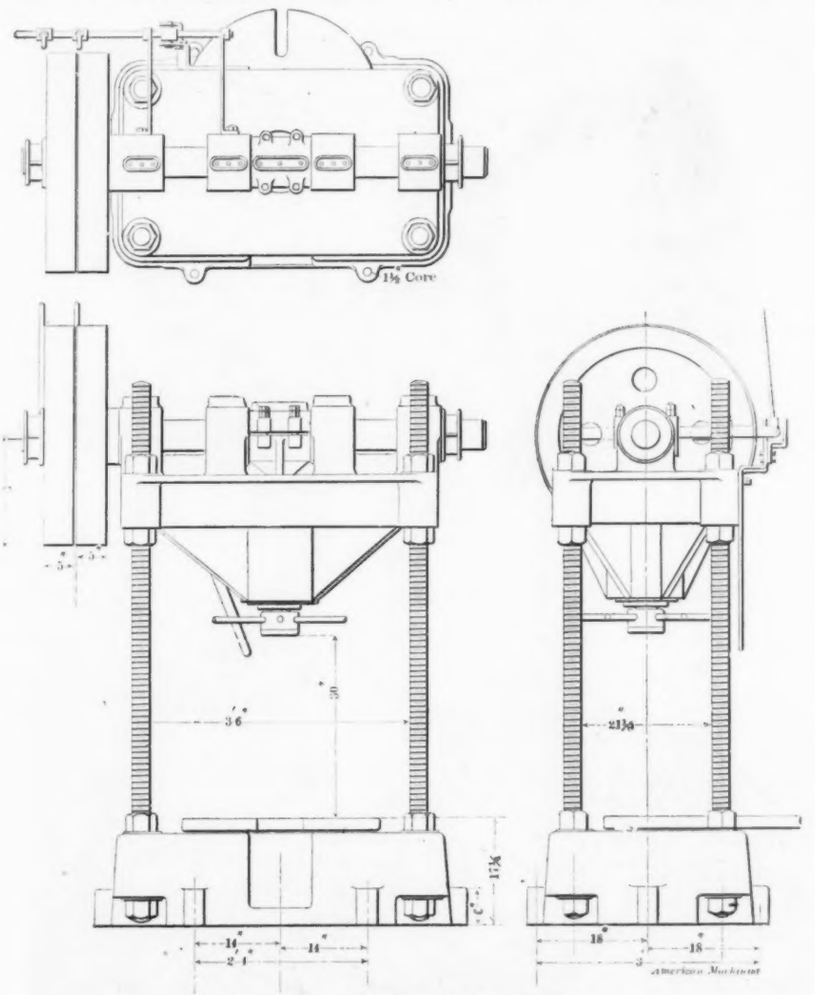


FIG. 2. A MACHINE-SHOP CRANK-PRESS.

PROVISIONS OF THE ACT.

The Naval Personnel act, approved March 3, 1899 (30 Stat. L. 1004), is entitled "An Act to reorganize and increase the efficiency of the Navy and Marine Corps of the United States." Its enacting clause is as follows:

"Be it enacted, etc., That the officers constituting the Engineer Corps of the Navy be, and are hereby, transferred to the line of the Navy, and shall be commissioned accordingly."

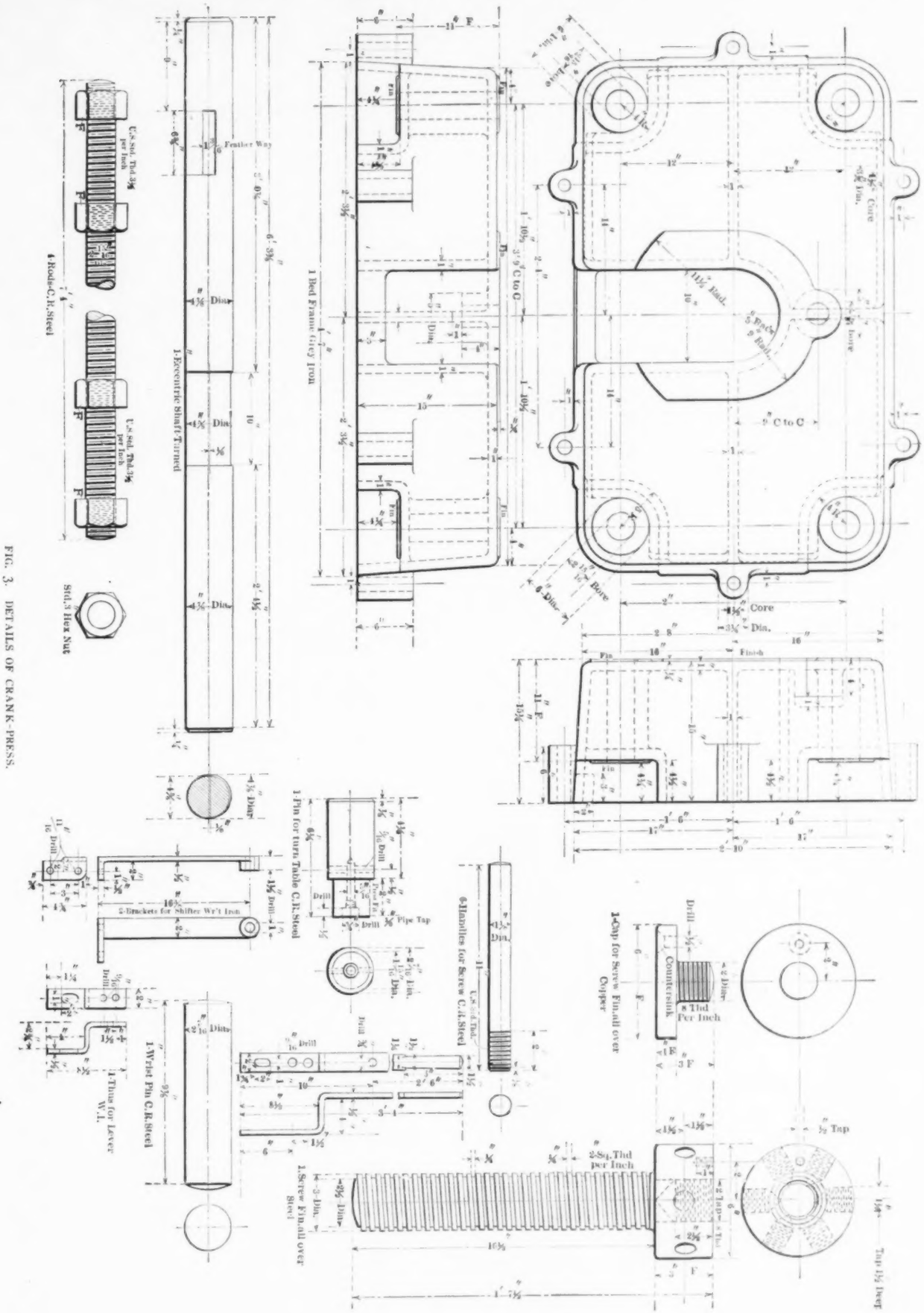


FIG. 3. DETAILS OF CRANK-PRESS.

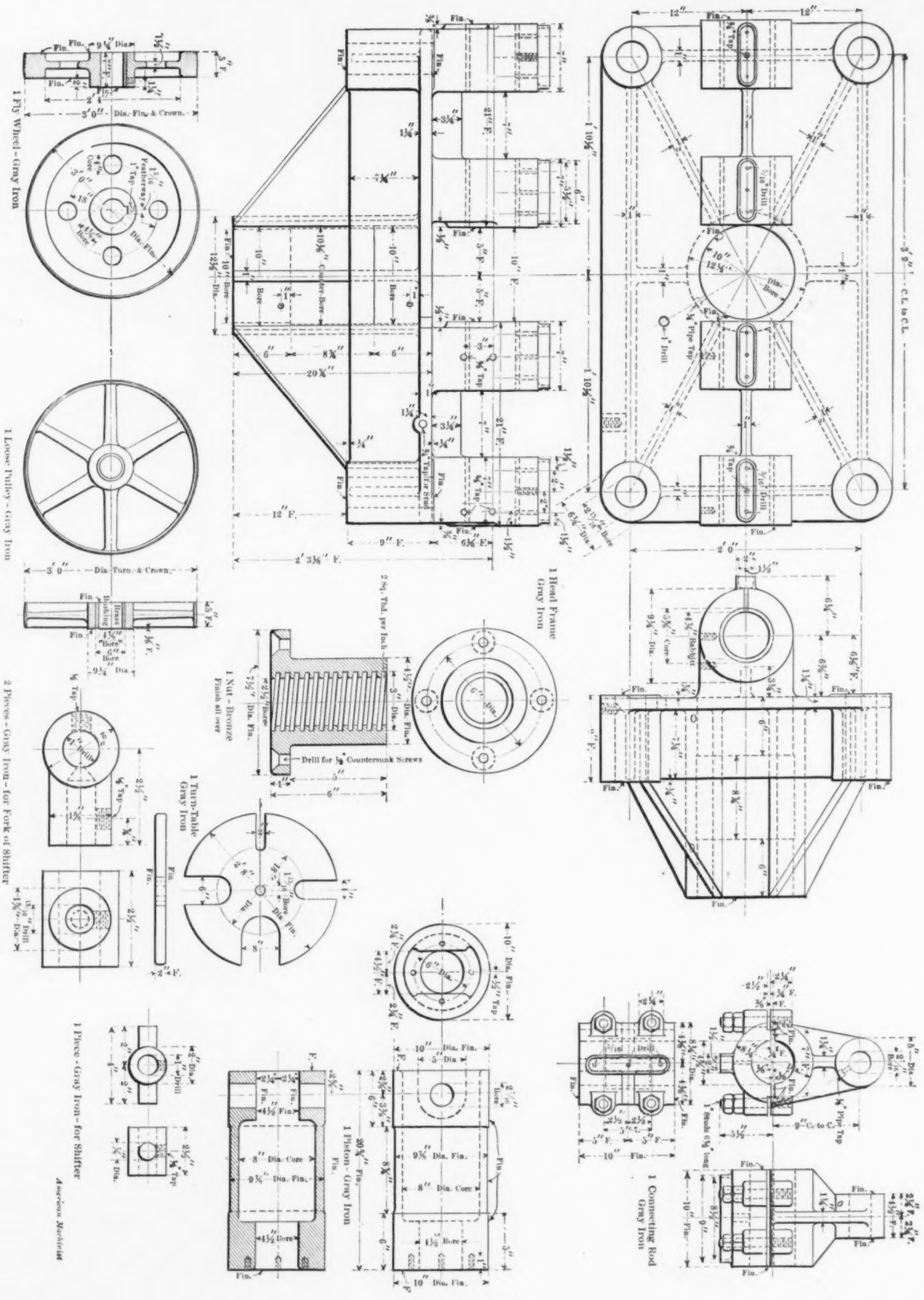

1 Fly Wheel - Gray Iron
1 Loose Pulley - Gray Iron
1 Head Frame Gray Iron
1 Nut - Bronze
1 Turn-Table Gray Iron
2 Pieces - Gray Iron - for Fork of Shifter
1 Piece - Gray Iron - for Shifter
1 Piston - Gray Iron
1 Connecting Rod Gray Iron
American Machinist

FIG. 4. DETAILS OF CRANK-PRESS.

Sections 2 and 3 provide for the rank to be taken by engineer officers thus transferred, and Sections 4 and 5 for the duties to be performed by them, those below the rank of commander, to "perform sea or shore duty," and such duty shall "be such as is performed by engineers in the Navy," and those ranking as, or above, commander to "perform shore duty only."

Section 14 authorizes the appointment of 100 "warrant machinists" who shall be "machinists by trade, of good record and in the naval service," or if a sufficient number from the Navy are not found duly qualified, "then any machinist of good character, not above thirty years of age, in civil life, shall be eligible."

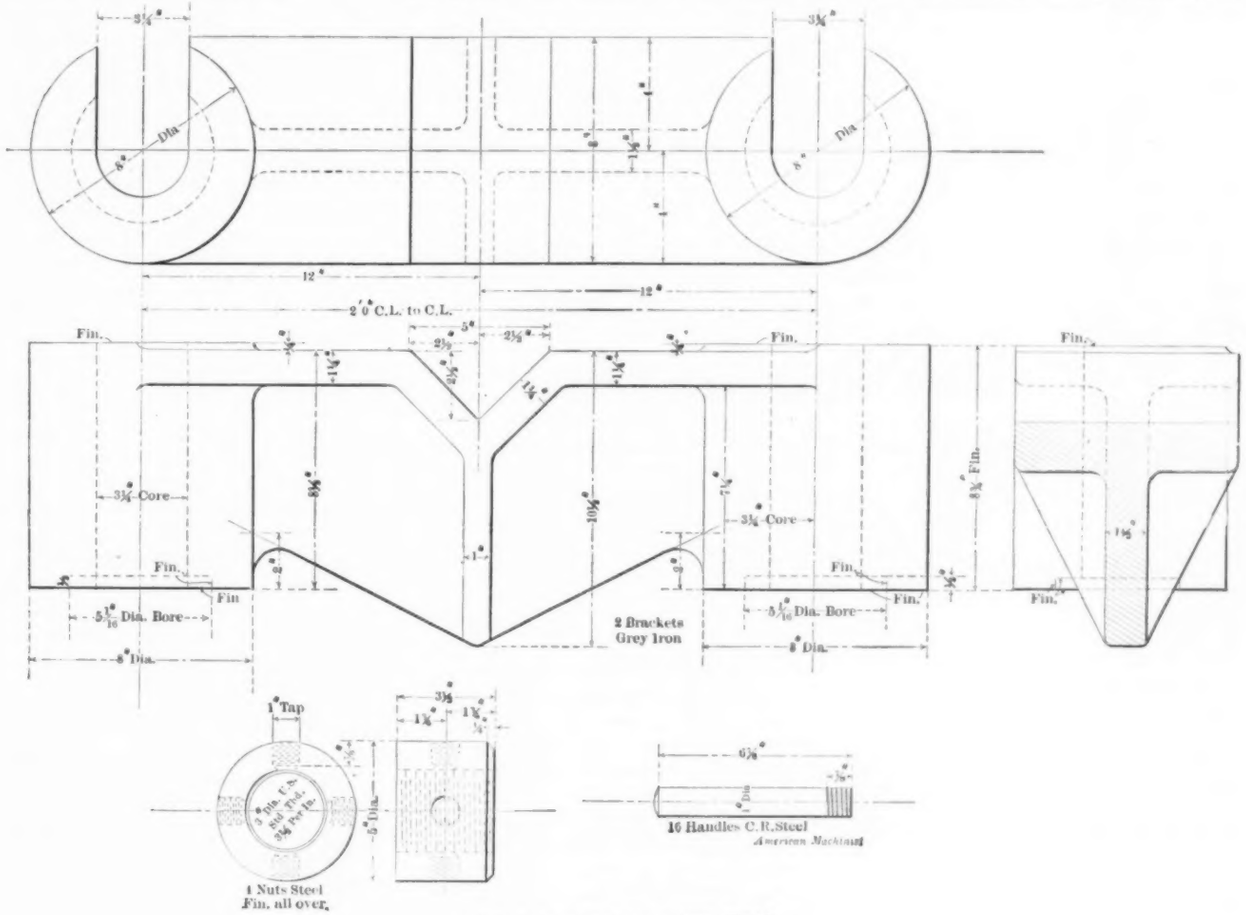


FIG. 5. DETAILS OF CRANK-PRESS.

Section 15 provides that the pay of warrant machinists shall be the same as that of "warrant officers" and that they shall take rank with other "warrant officers" according to date of appointment and shall wear such uniform as may be prescribed by the Navy Department.

It is to be noted that the act does not in any manner change the status of the commissioned officers of the Medical and Pay Corps, and refers to them only in Section 13, which fixes their pay and allowances as the same as may be provided for the officers of corresponding rank in the Army. The class of duty which is to be performed by the "warrant machinists" is not specified in the act, and it makes no provision for the performance of duty, as engineers, by commissioned officers other than the engineer officers which it transfers to the line, that is to say, by line officers who have not been trained as engineers.

Standing alone, and in the absence of a knowledge of the manner and circumstances of its administration, the provisions of the Naval Personnel act, above summarized, would apparently warrant the popular impression that its object and tendencies were in the direction of the advancement and elevation of the officers of the former engineer corps and the general good of the service. Circumstances, however, materially alter cases, and the correctness of this impression, which was largely based upon the commendatory expressions made as to the act by high official authority, before it had been tested in operation, is now so generally and gravely doubted, as, particularly in view of the "Bennington" explosion, to bring up for immediate and serious determination, the question of the advisability of its substantial modification or repeal.

CONDITIONS LEADING UP TO THE PERSONNEL ACT.

To seek to renew, at this late day, the long continued strife between the line officers and the engineer staff, in which, it may be noted, the medical and the pay staff officers have never been involved, would be both unprofitable and detrimental, and is, in no sense, my purpose. A consideration of what are believed to be the *latent*, but inherent imperfections and disadvantageous results of the Naval Personnel act, as developed in its operation, must necessarily include, to some degree, elements and conditions of the controversy which led up to it, but these are presented only as seeming relevant and essential, and in connection with what is sought to be made a fair and unprejudiced statement of facts and conclusions.

At the date of the presentation of the Naval Personnel bill in Congress, sails, as a propulsive power, had practically been supplanted by steam, and a power motor, either steam or electric, had supplanted hand power in every part of the modern ship. The question propounded in Luce's admirable work on seamanship as to "whether coal-whips would outlive tacks and sheets," seemed to be on the verge of a victory for the former. "Every man in the ship should be an engineer" was the opinion of many, and, so common had become the use of labor-saving machines, that every man in the ship had some knowledge of at least a small part of the group. Even the gun carriages

were "mechanical." This seemed the last straw upon the camel's back. With the disappearance of sail as a propulsive power the last vestige of romance of a life at sea is forever gone. Those engineers of the Navy who were active in promoting that so-called "amalgamation" hoped, and indeed, understood, that all future cadets graduated at the Naval Academy would be *engineers first,* and that they would devote themselves to that calling. With this in view, they wrought diligently for the passage of the bill, which they believed would make every officer a zealous engineer and raise the standard of the profession.

The Navy Department should be at liberty to secure, and should be aided in securing, the best talent the country affords, in each and every of its departments. It is patent that the most successful practitioners in any art, craft, trade or profession, are specialists. It must follow that these specialists have first, an aptitude and liking for their calling; and second, that they devote themselves assiduously to it. Any school boy knows that a week's holiday from his studies will so divert his mind from his books that he will find difficulty in resuming his studies. Every apprentice boy finds precisely the same kind of obstacle; and it will follow all through life, no matter what pursuits he may engage in.

It may be true that a number of the engineers of the Navy acquiesced in the Personnel bill, but it was because of the great flow of promotion and increase of pay. A greater number did not approve of the amalgamation clause. Had the "amalgamation" clause been separated and a vote taken upon it, the result would have been different. When an officer is asked what, in his experience, is the result of the Personnel bill, he invariably frames his answer upon that one little "amalgamation" feature, losing sight of the great question of the flow of promotion and increase of salary. Evidently that feature is still the potent matter of interrogation in his mind. A young ex-engineer was asked why he acquiesced in that measure, and his reply was that from the way the question was put there could have been no other than an affirmative reply.

THE PURPOSE OF THE AMALGAMATION.

The purpose of the amalgamation is generally supposed to be to provide the Navy with such general officers as will be able to do any duty which may devolve either on a line officer or on an engineer. Such a proposition is commendable in its object and attractive in its theory, but its practicability is manifestly questionable, and so far as can be judged from the operation of the act, its success is only in hope which will end in fruition. The theory of the Navy Department assumes that an officer may make a cruise, say, as navigating lieutenant; then spend a three years' detail at a navy yard on, say, ordnance duty; then make a three years' cruise in the capacity of chief engineer; then a three years' detail on shore at a hydrographic office; and finally be content to take command of a ship of war. This theory would, to the average mind, appear to both underrate the duties of a commanding officer and overrate the capacity of officers generally.

ADVANTAGES OF SPECIALIZATION.

While it may be possible for some officers of special ability and aptitude and of unusually great mental versatility to properly perform all these varied duties, and attain and retain the theoretical and practical knowledge essential to their performance, it is not reasonable to believe that all will be able to do so. Perfection can be and is attained only by specialization, in the learned professions, in the arts and trades, and in the conduct of commercial business. As well might an army officer be alternated between the duties of a drill master, a tactician, a military engineer, a pay director, and a surgeon and be expected to become competent in each, as for a naval officer to be called on to successfully run the gamut of navigation, international law, ordnance, engineering, and hydrography. In the conduct of civil business sentiment plays no part whatever, and those operations are most successful which are thoroughly specialized and conducted upon methods in which departments involving duties of different character are each directed by those who are trained in and familiar with their particular duties and free from the distraction and mental strain of attempting to become proficient in other duties which require different training. The merchant marine is operated upon the same lines, and is operated for commercial profit, which, particularly in transatlantic vessels, involves the attainment of the highest degree of safety, as well as the economical operation and maintenance of the ships and their equipment. These ships are navigated by captains and mates, their engines are run by chief and assistant engineers, their clerical, their steward and pay departments managed by pursers, and the health of the passengers and crew looked after by a medical staff. Each class of officers is trained in, and familiar with, the duties of its special line and does not attempt to interfere with those of the other classes. Such a system is logical, reasonable, and *successful,* and no intelligent manager of a steamship line would ever think of departing from it, even if the laws of the United States permitted him to do so, which they do not. No reason appears why the same operative principle is not applicable with equal advantage in the naval service, and, on the other hand, the objections to a unification in the same officer, of duties of widely differing character, are self-evident.

QUALIFICATIONS OF A NAVAL OFFICER.

Education, from the Latin *educare,* signifies *bringing up,* either in mental or physical training, or in dexterity. A man may be well educated in a trade; a pugilist (following one of the most degraded of all callings) is currently admitted to be "educated" in athletics and physical training, and is not infrequently acknowledged to be a professional. So it must be acknowledged that there is education and education.

The word "officer" is susceptible of very extended definition. In a military or a naval sense, an officer may be defined, briefly, as a leader of the men he commands. If we accept this primitive definition, it is evident that the officer should be trained in, and able to do, any work, no matter how difficult or dangerous, that any man under his command or charge may be expected to do. Judging from the practice which has prevailed in the Navy, this thought was apparently in the minds of the officers who inaugurated the Naval Academy and the Military Academy.

The art of seamanship, until very recently, was regarded as the very highest qualification of a naval officer. To accuse an officer of being "no seaman" was regarded as sufficient provocation for a duel. After the end of the Civil War an aged (retired) rear admiral was asked for some personal reminiscence of Raphael Semmes, who was, without doubt, a great naval genius. The admiral said frankly that Semmes was possessed of marked ability in many ways, "but in the old Navy he was not held in high regard because he was a poor seaman." It seems that Semmes, during the Mexican War was in command of a small sailing ship, and during some evolution had capsized his vessel very unnecessarily. Without derogating from the genius of Semmes, the admiral displayed genuine professional feeling in his view as to a brother officer who he thought had brought reproach upon the cloth.

INSTRUCTION AT THE NAVAL ACADEMY.

It was the practice at the Naval Academy to teach the students to knot and splice, and, on practice cruises (in sailing ships), to station the cadets in all parts of the ship, alow and aloft, where they did with their own hands all the practical work of a seaman. Such feats in practical seamanship as required skill, temerity and strength were performed by the midshipmen. Besides the art of seamanship, the cadets were required to perform manual exercises in drilling with great guns, fencing, boxing, drills in small-arms and target practice, where routine, and a satisfactory standing in each, was demanded. International law has always been considered imperative. Besides all these, a general university course is presumed to be given, including two foreign languages and also mathematics up to differ-

ential and integral calculus. The boy who can acquire all this in a four-years' course will accomplish an enormous task. While it is probable that our own navy officers are, as a rule, better educated than those of foreign nations, a scholarly education has never given any man a profession, and can only give him a foundation whereon to build his future professional edifice. If he has the industry, zeal, aptitude, physical strength, courage and *opportunity* he will become a great man; but in acquiring his greatness he will find it is through a specialty. If to all these studies we add engineering, we will overload the student; the endurance of the boy will be passed.

A boy is gifted with as much intuition as a man. He knows his own capacity and bent as well as does his teacher. If he has "gumption" he will strive for a "2.5" (satisfactory mark) in those studies which promise to yield him but little, but a 4 (maximum) in the studies which yield the most. It may be safely assumed that no "plebe" in the Naval Academy will be likely to prefer the chances incident to "engineering duty" to that of the admiral of a fleet; for these are the relative top rungs of the ladders between which he would be obliged in time to choose. It is the ambition of every boy to do well anything he undertakes, but he is ever anxious to excel in the most honorable and glorious undertakings. The young officer will prepare himself to *command* at the expense of all collateral duties; to enhance his success in the supreme moment that may come when he is in command.

The "amalgamation" clause in the Personnel act, while transferring the officers of the engineer corps to the line of the Navy, did not, *in terms*, abolish the engineer corps of the Navy, and were the Secretary of the Navy to nominate, and the Senate confirm, any man a chief engineer who was otherwise qualified, that man would take his place on the register as a chief engineer in the Navy. The transfer made by the Personnel act was, however, qualified. An engineer transferred to the *line* must pass an examination before being qualified to perform such duty, but the line officer was not required to be examined to ascertain his qualifications as an engineer. It was not reciprocal. This, notwithstanding the fact that engineering had arisen to such eminence that its importance should have been as well understood in Congress as elsewhere. It had grown to such proportions that it was subdivided into many specialties, and no one man could be proficient in all its recognized branches.

THE OLD ENGINEER CORPS OF THE NAVY.

When the steam engine first began to take merchantable shape, civil engineers turned their attention to designing it. This practice was continued until the better apprentice class of boys in the shops were promoted to the drafting rooms; this was the inauguration of the mechanical engineer, and from this class of youth the old engineer corps of the Navy was largely established. The system of educating boys first in the machine shop and then in the drafting room was adopted not only here but on the other side of the Atlantic, and from these the greatest mechanical engineers have sprung. A number of civil engineers (graduated by colleges with the degree of C. E.) took post-graduate courses in machine shops before beginning work as mechanical engineers, or before entering the engineer corps of the Navy (which many did). With the prospect of promotion, this new field before them, a number of well educated young men served as apprentices at the machinist's trade. This was the case in Europe as well as in the United States. The leading mechanical engineers of today, on both sides of the Atlantic, were educated in this way. As students they made books from their own notes, and thus each engineer compiled his text-books from his own notes and sketches. The printed matter on the subject of mechanical engineering was meager until a recent period. When the degree of Mechanical Engineer was first established in American colleges, those colleges drew upon the engineer corps of the Navy for their professors. When the course at the Naval Academy was amplified during the Civil War, a number of these engineers were assigned to duty there as teachers, not only in the science and art of steam engineering, but in natural and experimental philosophy, chemistry and physics; one was even teaching the French language. From that time the course at the Academy has been greatly improved. There can be no question that the Navy was then obtaining the best talent the country afforded in engineering.

The first steamship was built for the Navy in 1814; she was blown up (by her magazine) in 1829. The next was built in 1837; in 1841 several were built; in 1845 the Naval Academy was put in operation. In 1843 the engineer corps of the Navy was inaugurated upon the plans of the Engineer-in-Chief, Charles H. Haswell. It may be interesting to note that on the twenty-first anniversary of the inauguration of the Academy, the first class of engineer students entered.

THE HUMANIZING EFFECT OF STEAM.

It is not curious that these important events followed each other so closely.

Up to that time men were stripped and stretched across guns and flogged; the sight of the welts upon their backs and the blood trickling down their sides has caused more than one midshipman to faint. Grog was served twice a day to the crew. There was a pitcher of whisky upon the sideboard in the wardroom by the time the retreat from quarters was beaten. Drunkenness and dueling were not uncommon. There is one account of a duel between two midshipmen, after which one was court-martialed, not for maiming his shipmates, but for debt; not one word was said about the duel.

But this cruelty and recklessness disappeared before the breath of steam, not only on board ship but on dry land. The old volunteer fire companies who went to a fire more to fight than to extinguish the flames, have disappeared, and in their places are disciplined operators of steam engines; and the process of subduing the flames is now conducted in so orderly a manner that a fire may be within a block of us without our knowledge. The striking and fighting longshoremen have been decimated by the hoisting engines on the wharves. The brutal goading of the stage-coach horses has disappeared before the breath of the steam locomotive. The practice of driving men aloft with a ropes-end, and shotting a man on the yard arm —practiced in the sail period—terminated when a line of ocean-going ships was inaugurated.

It is true that the immense strides which have been made in mechanical, agricultural, and moral pursuits have been particularly favored by a liberal government for the people and by the people, unfettered by religious persecutions and not retarded by superstitious cult. It is largely because we have been able to banish the identity of the individual in our official acts, that we have been suffered to select the men for their capabilities, and not because they were the sons of their fathers. It should not be claimed that a man's abilities, rights and privileges are determined by his graduation, for some men acquire and others lose knowledge after that important event.

SEPARATION OF DECK AND ENGINE DEPARTMENTS IN MERCANTILE MARINE.

The disagreement between people practicing the old mode of propulsion (sails) and those who practiced the new (steam) began the first day steam was installed on board a boat; it was developed not only in this country, but also in others, and appears to have been inevitable. In the mercantile marine, where everything is reduced to a money-making basis, the stockholders very soon made a permanent divorce between the deck and the engine departments. To them has been added the steward's department (or purser's department), which organization is also separate, as well as a medical staff, and this is not only the rule here, but also in all other civilized maritime nations.

The first important expedition fitted out by the United States Navy, and which was composed of steamships, was the Perry expedition to Japan, in 1856, and Commodore Perry adopted the above plan. He suffered no person—save himself—to give an order to his chief engineer. He rarely went on shore without an engineer;

not that he had any particular liking for them, but because they were useful. Perry's expedition was a pronounced success, and his methods prevailed in the Navy for many years. So successful were the steamers under his command that he has been called the "father of the steam navy."

The old engineer corps of the Navy was selected from civil life. At that time and in the early days there were no schools giving a course in mechanical engineering, but a few gave mechanical drafting. Engineering students were obliged to "pick it up," and at that time it was the practice of every engineer to carry his note and sketch book at all times, and to avail himself of every opportunity to sketch and note.

Now there are many colleges giving an excellent course in mechanical engineering, whose students have had shop experience, and many of whose graduates would be glad to enter the Navy in a subordinate capacity, *provided it were possible for them to rise to the commission of a chief engineer in the Navy.*

MACHINISTS IN THE NAVY.

It seems to me that the Navy abandoned an excellent method at a moment when it could have availed itself of the best opportunities. Instead of this, however, men in the rating of "machinists" are enlisted, who may, in time, be promoted to be "warrant machinists." But they can go no higher. These men are substituted for engineers; they are the *de facto engineers,* without their rank, rights or privileges. The *warrant machinist* on board takes the place of the old "first assistant," who was always the working engineer. But instead of the chief engineer there is "an officer to command the engineers' division, the same as any other division in the ship." In a short time the present engineers who have been, by the Personnel act, transferred to the line of the Navy, and who are now the *de facto* chief engineers, will have retired, at which time the system of shifting an officer from one kind of duty to another must follow.

The "machinists" are acquiring more and more experience and growing more and more valuable; and no one knows this better than themselves. In time they will be depended upon; it is the inevitable. These men are human; they have the same spirit of ambition, the same consciousness of self-worth, and the same spirit of jealousy that are found in any other men. If they are depended upon they will be conscious of their responsibility. If they have responsibility and do well what is given them to do, why should they not, in this Republic, be entitled to promotion? They have brought into the service an education not taught in the schools; they have acquired an experience which makes them of value.

The watch engineers (usually enlisted machinists) have under their command from 10 to 50 enlisted men—oilers, watertenders, firemen and coal-passers—and yet they are obliged to live on the same berth deck, sleep in similar hammocks, eat and live with and muster in line with the men they command. Under these circumstances, is it reasonable to believe that such discipline as is essential to efficient service can be maintained? The Navy Department, in its wisdom, has separated the apartments of the commanding officer, the ward-room officers, the steerage officers and the warrant officers, to the end that they may not become familiar. This has ever been regarded as a wise and proper method of promoting discipline. The question naturally arises as to whether or not we should expect of enlisted men what has not been expected of commissioned officers.

SPECIALIZATION IN ALL LINES EXCEPT THE NAVY.

While all the world is specializing, our Navy alone is generalizing. The medical profession is divided into numerous specialists; naturalists are very widely divided into specialties; mechanical engineering, which had no text-books worth mentioning 40 years ago, is now divided into many specialties. The highest mathematics is not necessary in the practice of any profession employed on board ship; its use is essential to establish those arts, but not to practice them. There is so much more use for the practical than the theoretical education on board ship that men become rusty in the latter. After all, the success of officer or sailor depends largely upon common sense and habit; what he does habitually he does well.

Every nation has become strong and rich and great in proportion to the number and skill of its producers, its mechanics, its farmers, its artists. This was strictly so during the dynasties of ancient Egypt, and it runs through the times of ancient Flanders; all through the Dark and Middle Ages, down to the present period. The careful reader will note that decay sets in with the creation and recognition of *caste;* that which our early legislators designated as "a privileged class." It has been said that history repeats itself, and it is equally true that human nature repeats itself. We may expect a repetition of the decay as well as of the budding and blossoming of our Republic and our hope should be that we may meet and overcome the exigency of decay, and if we cannot defeat it that we may at least retard it. It cannot be expected that the present *soi disant* machinists will remain satisfied with their life or position on board ship. The better of them will seek and obtain better employment; the residue will be those who, from ill health, bad habits, misfortune or other embarrassment, are forced to remain. Does any commanding officer want to go into battle with inferior men in charge of the motive power of the ship?

UNLICENSED ENGINEERS ON UNITED STATES WARSHIPS.

More than fifty years ago Congress enacted a law which forbade any person other than a licensed engineer from working the engines of any mercantile vessel more than 100 feet away from the wharf. But now unlicensed and uncommissioned engineers are moving United States warships all over the ocean. *A merchant ship engineered in this way would not be suffered to leave New York harbor.* A number of navy "machinists," however, having a pride in their calling, keep themselves in good standing as regards their license. The Navy should be careful not to abandon its seamanship. Good seamen will be needed to man sailing prize-vessels in every war. Twenty-five years ago it was estimated that Great Britain had coal enough in its mines to supply the world a century at the rate of consumption at that time, but in ten years the consumption had quadrupled, and now it is ten times as great. Forty years ago the largest transatlantic liners were each consuming 120 tons of coal a day; twenty years ago they had reached 300 tons; to-day the largest are consuming 450 tons of coal a day. A few years ago "tramp" steamers monopolized the carrying trade, and very few sailing ships were being built. But, owing to the increased consumption, the price of coal has so advanced that it is not so profitable to carry freight in steamers, which accounts for the increased activity in sailing-ship building. The rapid increase in coal consumption and the increased difficulty in obtaining it will probably, in the near future, again calls "tacks and sheets" into requisition; and if, in the meantime, all naval officers become engineers, it may be discovered too late that a serious mistake has been made. The conversion of all engineers into deck officers would be a corresponding error, and the course which is both reasonable and advantageous is the limitation of each class of officers to the duties in which they are trained, and with which they are, or should be, fully familiar.

THE PERSONNEL ACT AND THE "BENNINGTON" DISASTER.

In the absence of official information as to the "Bennington" explosion, the relation of the operation of the Personnel act thereto can be only generally considered, and the extent of its bearing thereon is not here sought to be urged. It is not, however, believed that such, or any, present consideration of the system under which the engineers' department of the ship was operated, involves an immature judgment of the question of responsibility, or prejudices an impartial one upon the facts when they shall have been officially made known to the public. The evils or defects of the system, if they are found to exist, neither impose added responsibility upon the officers and men who do duty under it, nor

relieve them from that with which those in their positions are properly chargeable. So far as the material and the responsibility of the personnel of the "Bennington" is concerned, there should be a complete suspension of public judgment, pending an official report, but this does not bar a discussion and criticism of the act and its results, possible, probable, or actual.

The statements of the public press, which, like all items of news, must be accepted subject to whatever official correction may be required, are to the effect that the engines and boilers of the "Bennington" were operated by *enlisted men*, under the charge of an "ensign," *not an engineer officer*, and only twenty-six years of age. This organization was the result of the Naval Personnel act, and while the line officer in charge may have done his duty to the extent of his ability, for whatever lack of ability or technical training there was in his case the system under which he was assigned to engineering duty is manifestly answerable. Such a state of affairs would be impossible in the merchant service, intolerable if possible, and if it is correctly reported, imperatively demands a radical reformation of system and operation. It is not claimed that the explosion could not have occurred if the engine department had been in charge of engineer officers, as in the period of the existence of the engineer corps, but it is manifest that the probability of its occurrence would have been very largely reduced. On the other hand, no one familiar with steam machinery can deny that the conditions existing were such that the liability to damage or disaster was materially greater than if the engine department had been in charge of a chief and assistant engineer officers.

PREDICTION OF THE ENGINEER IN CHIEF OF THE NAVY AND ITS FULFILMENT.

In a report of the Engineer in Chief of the Navy before the enactment of the Naval Personnel bill, it will be found that he urged Congress to increase the number of engineers in the Navy, and predicted that if action was not taken to provide a greater number of competent engineers, disaster might be expected. His views were confirmed by the present Engineer in Chief, who, as late as 1904, said that "the present condition of engineering in the Navy is a cause of grave anxiety to all conversant with the subject." Instead of providing more engineers, their number has actually been reduced, and whether or not the relation between cause and effect exists, history will present the terrible record of the "Bennington" disaster as closely coincident with the elimination of engineer officers, as a corps, from the Navy and the substitution of enlisted men, as watch engineers, for trained and competent engineer officers.

If, as I believe, the operation of the Naval Personnel act is indirectly the basis of the worst disaster of its character that has ever occurred in the United States Navy, it is plainly the duty of Congress to repeal the act, and substitute for it a measure under which engineering duty will be done by engineer officers, commissioned upon sufficient and approved technical education and training, and with rank commensurate with the importance of their duties and the respect and obedience which should be paid to them by their subordinates in the maintenance of thorough and effective discipline. The propriety and necessity of such action is a question of national and of immediate importance, and the judgment of the people of the United States should be passed upon it intelligently, and emphatically and unmistakably expressed.

Two Special Grinding Machines.

EDITORIAL CORRESPONDENCE.

The De Loach Mill Manufacturing Company, of Atlanta, Ga., is one of the developments of the New South, and in its line of saw- and flour-mills is one of the largest in the South. In connection with the manufacture of its regular products it has, naturally, many belt pulleys to make, as well as many friction disks for feed works. The accompanying illustrations show two machines of its own manufacture for these pieces of work, which it finds far more economical in use than lathes.

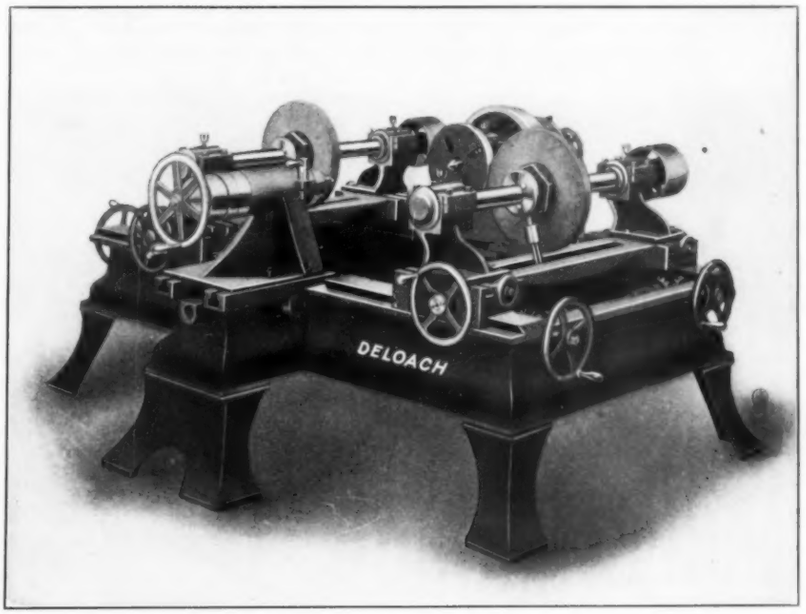


FIG. 1. PULLEY GRINDER.

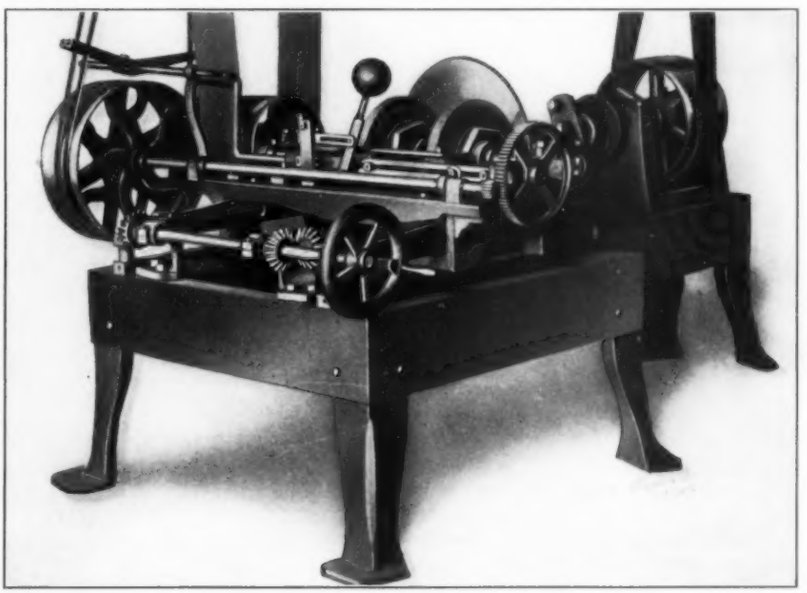


FIG. 2. DISK GRINDER.

The pulley grinder, Fig. 1, is almost

self-explanatory. The grinding wheels may be set for straight or taper grinding, the wheel carriages being adjustable bodily to and from the work by the hand-wheels mounted on the bed, while the taper is adjusted by the smaller wheels above. The grinding wheels are mounted on their shafts with feathers and splines, and are reciprocated by arms which connect collars on the wheels with screws below the carriages and out of sight, these screws being driven from the work-driving pulley by gearing on the far side of the machine.

FIG. 1. THE OFFICE.

The disk grinder, Fig. 2, is more unusual in design, and is really remarkable in its capacity for work. Two emery wheels will be seen to be mounted in a single spindle, on which they are reciprocated, as in the former machine, but through the agency of special open and crossed shifting belts. The hand-wheel in the foreground adjusts the wheels to the work. F. A. H.

Vacations.

"The summer vacation is one of the most useful of business customs," declared an employer. "By means of vacations the employer gets a line on his men. For instance, Mr. A is away two weeks and his work is done by young B, who accomplishes more and makes suggestions that are worth following. That means that A's department is going to turn out more work from that time on. Then perhaps old C takes a month and leaves his assistant in charge. If things go to pieces it means that C needs a new assistant, or that C is selfish about developing a possible successor. In any case we have learned something mighty interesting and useful."—*N. Y. Sun.*

The New Addition to the Works of J. H. Williams & Company, Brooklyn.

Of the origin of the art of forging, nothing is known, but the smith and his work are referred to several times in Holy Writ. In Genesis, Tubal Cain is described as a worker in brass and iron. In Judges iv. 17-22, we read that Jael, the wife of Heber the Kenite, "put her hand to the nail and her right hand to the workman's hammer," and drove the nail into the forehead of Sisera as he lay asleep.

FIG. 2. THE CLUB-ROOM.

In the Middle Ages every hamlet and castle had its complement of armorers to make and repair the implements of peace and war.

That the Smiths were a prolific class there can be no doubt, for the hordes of their descendants may be counted in any city directory. In that of New York, I find thirty-three columns of Smiths and Smyths, and nearly eight columns of the Teutonic varieties, while there are only seventeen columns of Browns and less than half that number of Jones.

The occupation of the smith was held in high esteem, and rightly so, for the swords, halberds, maces and suits of armor made by them are works of art. Some of the suits of mail displayed in the world's finest collection of armor, at the Tower of London, must have taken months, if not years, to make.

With the advent of firearms, the use of armor naturally declined, and the armor smith was succeeded by the gun smith, in what we call civilized countries.

I suppose the armor and arrow and sword smiths' guilds or unions of those ancient days put up the same howl about the introduction of labor-saving devices for the destruction of enemies as those of more modern times have about the installation of machines in lieu of hand work for manufacturing. But the product of the gunsmith eventually made the production of uniform forgings necessary, and the way to make such forgings once found, their use has spread until there is no branch of the metal industries in which, either directly or indirectly, they are not used.

Modern forging is done by three methods—hand forging, trip or steam hammer and the drop hammer.

Without doubt, the first step toward machine or drop forging was the use of top and bottom dies, with the desired form cut in the dies, the upper die being struck

with a sledge while the iron was held between it and the lower one.

The upper die slid on guides and was held away from the lower one by light springs. The iron was first worked into approximately the desired shape by the blacksmith, it was then re-heated and placed between the dies and held there while the helper brought it to the required shape by striking the top die. The light springs lifted the top die each time, and which shaped the rough bar to approximate form, and walked around the machine from die to die till the forging was finished.

The next improvement was by a Providence concern, who about 1862 used friction rolls to raise the hammer, a leather belt being attached to the hammer and passing between them. Thereafter improvement followed improvement till we have the modern drop hammer for heavy work, with the ram weighing a ton or more, lifted by the friction of rolls on a maple board.

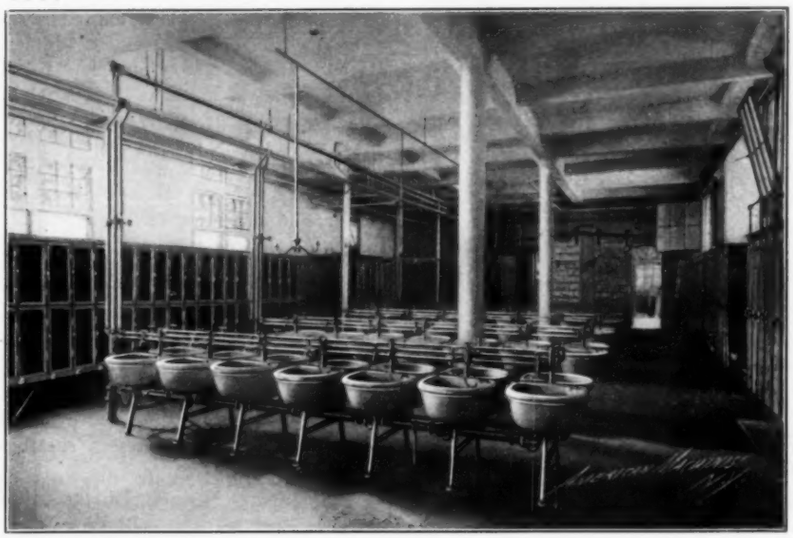


FIG. 3. THE LAVATORY.

made it possible for the smith to remove the finished forging from the dies without trouble. As late as eighteen years ago there was a small shop in Glasgow, Scotland, where numerous small articles were forged in this way.

About 1850 the British Government was making the Enfield rifle. These rifles were produced much in the same way that the cheap imitations of Smith & Wesson revolvers are now in Belgium.

The barrels were supplied by individuals skilled in making them, others furnished the locks, others the stocks, and so on, the parts being finally assembled at the Tower of London.

It is not to be wondered at, that—with the component parts produced in this manner—the assembler's lot was not a happy one, the rifles costly to make and unsatisfactory when finished. Each part of each gun was fitted as a part of that gun only and would not fit any other. The necessity of having duplicate parts did not filter into the governmental brain until about 1855, when machinery was ordered from the United States to manufacture the Enfield rifle on the interchangeable system.

Colonel Samuel Colt, maker of the celebrated Colt revolver, was the first to successfully use a drop hammer for forging purposes. His machine was of cylindrical form, having four or more heads into which dies were fitted. The operator began at the first or breaking-down die,

The first requisite in order to produce a drop forging is to have correct drawings or—for pieces where the shape is not readily shown on paper—a wooden model. This, together with a scale drawing, the required weight of the finished forging, number of forgings required and the limit of variation allowable from the specified dimensions, is given to the die-sinker. He selects the die-blocks, and decides upon the parting lines of the dies—much the same as a patternmaker does—so that the finished article will draw out of the dies. Unlike the patternmaker the die-sinker cannot make use of cores, loose pieces, etc., and the die is almost invariably limited to two parts which must stand the severest handling.

The tools used to remove the metal from the die-block depend upon the shape of the die. Die-sinking machines, milling machines, lathes, planers, shapers, in fact all the machine tools in common use in machine shops—and a good many that are not—are used by the drop-forge die sinker. Hand work is often necessary; hammer and chisel, files, scrapers and emery cloth being used as occasion demands.

As it would be practically impossible to place sufficient metal in the dies to exactly fill them without any surplus, it is necessary in order to have perfect forgings to use metal of such dimensions that it will more than fill them, so a gutter or groove is formed around the image in the die-block to take care of this surplus called the "flash." The flash is trimmed off by dies called trimming dies, either while hot, or after the forging is cold, as circumstances demand.

After the dies are finished, but before they are hardened, lead is poured into them and the lead sample thus made is sent to the customer for his approval. A variation of .002 of an inch in size either way is not an unusual requirement.

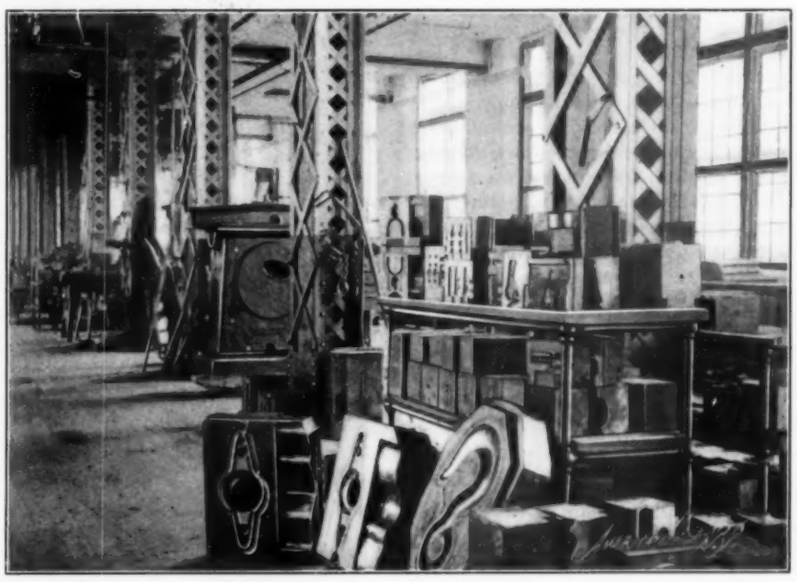


FIG. 4. THE SHOP.

At J. H. Williams & Co.'s plant oil is used as fuel for the forges. It is sprayed into the furnace by compressed air and is said to be more satisfactory than gas or solid fuel. The forging heat for steel is about 1,500 degrees. It takes from ten

to twenty blows to complete the average forging, which is allowed to cool and is then pickled in dilute acid to remove the scale previous to trimming.

The trimming dies are made and used much the same as an ordinary blanking punch and die, except that the punch or uppper trimming die fits the contour of the forging so as not to distort it when pushing it through the die.

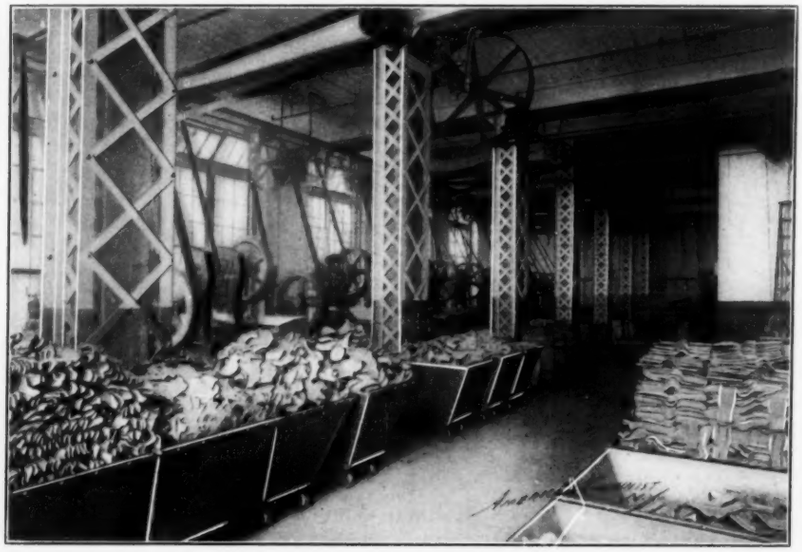


FIG. 5. THE TRIMMING DEPARTMENT.

J. H. Williams & Co. do not make dies to be used outside of their own works. The price of the job is so arranged that the dies remain their property but subject to the order of the customer only. After finishing an order the dies are put away together with one of the last forgings made with them. On receipt of a repeat order the sample forging is inspected and tells at a glance the condition of the dies. As drop-forge dies go the "pace that kills" their lives are very uncertain: a die may break down on the first stroke or it may turn out 20,000 forgings.

Forgings are made from aluminum, tobin bronze, copper, iron, tool steel, but by far the greater part of the product of the company is made from open-hearth and bessemer steel. Of these steels about a carload a day is used.

THE NEW BUILDING.

The new addition to J. H. Williams & Co.'s works is a brick structure four stories high, 50 feet wide by 200 feet long. Ample elevator service both for freight and passengers connects the various floors.

The top floor, shown at Fig. 1, is occupied by the offices. Here also is housed the exhibit from the World's Fair (itself well worth a visit). Windows on each side and one end, and skylights in the roof make the office as light as day, and this, the office of a "smith's" shop, compares favorably with the offices of some banks that I have in mind.

The third floor is occupied by the finishing department. Owing to the darkness of the day and the fact that the finishing department was running at high pressure, I could not get a photograph. Here are finished the wrenches, "Vulcan" chain pipe wrenches and other specialties made by the concern. The tools used here include those usually found in machine shops.

FIG. 6. THE STORAGE OF FINISHED GOODS.

On the third floor is the club-room, shown at Fig. 2. It is equipped with comfortable arm chairs where the employees may sit and eat their lunch. All the mechanical papers are on file, as are also the *Sun* and *Times*. Around the walls are arranged the diplomas awarded the company at various expositions. There is a grand piano and the superintendent informed me no lack of talent among the men.

On each floor is a lavatory, as shown at Fig. 3, equipped with expanded metal clothes lockers, shower baths and individual wash basins of stone ware, with hot and cold water.

The diesinking department is on the second floor. Fig. 4 shows one end of the room, together with a number of dies. In this department twenty diesinkers and eighteen trimming diemakers are employed. The machine tools include those usually found in machine shops, together with twelve Pratt & Whitney diesinking machines. An idea of the size of the dies shown may be gained by looking at the pair of dies to the left of the hook die; these are 16 inches wide by 20 inches long. In Fig. 4 the construction of the pillars may be seen. They are of yellow pine surrounded by steel work.

The floors throughout the building are wooden, 7 inches thick, made up of two thicknesses of 3-inch planks (one layer of which is laid diagonally) covered with 1⅛-inch hard maple flooring. Between the various thicknesses sheathing paper was laid.

The building is equipped throughout with sprinklers. One is struck by the appearance of the variety of lines of pipe running through the building, each system having a distinguishing color, so that there is no need to trace a pipe to its source to find out what it is. All hot pipes are painted black, gas pipes green, sprinkler pipes red, and drinking-water pipes are covered with a thick white sheathing of

non-conducting composition. A five-ton refrigerating plant cools the drinking water used throughout the factory.

Fig. 5 shows a part of the trimming department on the first floor, with trucks filled with forgings in the foreground, and the trimming presses around the sides of the room. Fig. 6 shows a part of the storage for the finished product. Formerly all finished goods were stored in bins; now there is a combination system—the larger and heavier pieces are kept in bins, shown in Fig. 6, at the bottom, and the lighter pieces are stored in steel tote-boxes, shown at the top in the same figure. A gallery runs round the storeroom bays to permit easy access to the tote-boxes. Each of these boxes and bins has a distinguishing letter and number—as J54. The stockkeeper has a record of the number of pieces in stock, and a glance at his list will show how many pieces are in J54 or any other tote-box or bin at any time.

Although everything that is possible has been done, not only for the comfort but for the safety of the employees, accidents will occur and a room near the entrance on the first floor has been fitted up as a "first-aid" hospital. The floors and walls are laid with white porcelain tiles, and there is a complete equipment of the necessary surgical and medical appliances, including an operating table.

The basement of the building is used for storage.

A large shear is located in one of the stock sheds. This shear is for cutting material into convenient lengths for the forge shop, and will shear 5-inch square steel. It is said to be the largest shear in the country in use in a drop-forge shop.

E. A. S.

Chinese editors are polite. A Pekin author who had submitted a manuscript to an editor received it back, not with an ordinary "rejected with thanks," but with this characteristically polite letter:

"Illustrious Brother of the Sun and of the Moon—We have perused your manuscript with celestial delight. By the bones of our ancestors, we swear that we have never met a masterpiece like it. If we publish it, H. M. the Emperor will command us to take it as a criterion, and to print nothing that does not equal it. Since that could never be possible in ten thousand years, we return your manuscript, trembling and asking your mercy seventeen thousand times."

According to the *Brass World* a Liverpool physician claims that appendicitis, in many instances, is caused by antimony. He attributes the entrance of antimony into the stomach and intestines to red rubber, which is used on many kinds of bottled and canned goods. Red rubber is colored by the use of sulphide of antimony.

Lathe Design and Practice—II.

BY E. H. FISH.

THE CROSS-SLIDE.

Let us next consider the cross-slide. The dovetail slide, either one or the other side up, has been in use so long that one must have considerable temerity to propose any modification, but in Fig. 6 is one which I have hoped to try for some time. It is not necessarily so very expensive with proper planing or milling jigs. A taper packing at *b* draws the slide over to the left against the vertical surface at *c*, and also down against the flat surface at *d*. There is no bearing at *e*, but there is a gib at *f* bolted solidly up to the slide with screws under tension and preferably adjustable only by scraping away its contact surface with the slide. If the designer must have an adjustment here, this gib may be made with a taper seat against the slide and by having slotted holes for the screws it can be moved endwise to take up wear.

The reason for introducing a vertical surface at *c* is that the one at *e* is necessarily narrow and of little use. Since most feeding and all face-plate work is toward the left, this brings the wear on the packing at *b* and tends to preserve the straight surface at *c* so that re-scraping the packing side is all that is necessary to straighten up the slide after it is worn. The wear at *d* is over so large an area that it will wear hollowing only after a long time, and is then easily gotten at with a surface plate for re-scraping. No wear comes on gib *f*, except when using a boring tool held in the tool-post, when it takes the strain squarely and is much better placed than in the usual dovetail slide of Fig. 7, where the tendency to turn about *c* as a center brings the strain anything but square with the surface which resists it at *f*. Worse yet, it is usual to see the packing held in place by a number of little set-screws which cannot possibly be set up with anything like a steadying stress without locking the slide. The effect of loose set-screws holding up a loose packing to take a variable stress is so apparent that it seems impossible that any lathe designer should use it. Nevertheless, almost all our tool designers, myself included, have, and probably always will, use this device, because it is cheap, and profits must be made somehow. When this arrangement is new it is almost always good, as the packing is driven in and just scraped enough so that the slide will move and the packing screws are used only to lock the cross-slide. The trouble only comes when the slide begins to wear. Much of this trouble may be avoided by putting the packing on the other side of the slide at *c*, as then there is a solid surface at *f* to take the stress when boring and the wear on *c* may be scraped out, using surface *f* to go by.

THE CROSS-FEED SCREW.

The cross-feed screw is usually much too small for the stresses likely to come on it. I have noticed cases where the pressure on the threads of the nut must have reached fully 2,000 pounds per square inch. The conditions of this screw are different from those of ordinary pressure screws, in that the very chattering or vibration which we are seeking to avoid helps to allow the cross-feed screw to be put under nearly if not quite the full pressure due to the turning of the handle, the usual loss of pressure due to friction being annulled by the constant vibration. Then, again, these screws are almost always under compression, and they are long and slender. Every pressure springs them and every let-up of the work releases the tension. They are constantly acting like springs.

A plan which I have used with good effect for heavy-duty lathes is shown in Fig. 8, which represents the end of the cross-feed screw at the back of the lathe. Securing the screw at this end permits the use of good-sized thrust collars and a washer on the outside large enough to take the stress at a reasonable pressure per square inch. (A ball bearing here is a probable outcome of the use of high-speed steel.) Moreover, it brings the screw under tension during the large majority of kinds of work. But even with larger cross-feed screws and screws held under tension there is left the alternate tension and relaxation due to inequalities in the chip being taken. This leads to the suggestion of some ready means of binding the cross-slide firmly to the carriage, instantly and handily. The form of slide of Fig. 6 is especially well adapted to this, since it is only necessary to lengthen one of the binder nuts holding the gib *f* and provide it with a handle. If we use the front nut and use a cut-away tailstock, this will not be in the way of anything and will be handy for the workman.

The swiveling plate for the compound rest is readily made secure by a circular tee-slot and bolts, three preferred. The use of the cross-slide of Fig. 6 encourages us to make the bridge of the carriage wider than usual, which is just so much gain. There is little use in lengthening out the carriage without making the bridge wider to resist torsion except from an advertising point of view. It makes it necessary to use an overhanging tailstock, but since all parts of the tailstock may be rigidly clamped when in use, it is much better to lengthen out the tail bearing than to take away from the cross-slide stiffness.

THE COMPOUND REST.

The compound slide is open to the same objections as the usual form of cross-slide, except that it is usually clamped up

solid and not used at all. In Europe they have a habit of using their compound slides as an extra slide parallel to the bed which we, with our better-designed lathe aprons, cannot afford to follow. Nevertheless, we have aped their fondness for a compound rest, and most buyers now insist on it, though it seldom happens that it is used once a year on more than one lathe in fifty. It only adds two more joints between the tool and the bed and a few dollars to the cost of the lathe, and takes away a good many more dollars each from the output. Since it is used so little, we may as well leave it (if not off) with a taper packing on the left-hand side, as suggested for the cross slide of Fig. 7.

As regards the use of the compound rest versus the taper attachment, there are two considerations which apply to work within the range of both. One is that the taper attachment allows of power feed, while, except on large lathes, the angular feed of the compound rest is by hand. Against this is the fact that usually the taper attachment introduces another slide in the rest, which adds to the general weakness of the structure. The compound rest adds another slide, but it is up nearer the tool, where it does not have as bad an effect as it would lower down.

The tool-post, with a cupped ring and rocker, is a cheap and nasty device to save the tool dresser and grinder from having to use care. No one ever thinks of having to rock a tool on a planer to get the clearance right, and there is no more need on a lathe. All this talk about setting the tool above the center, etc., means simply that blacksmiths make tools with so much clearance that they have to go above the center to cut at all. It is just as easy to get this clearance correct on a lathe as on a planer if our tools are kept somewhere near the right height.

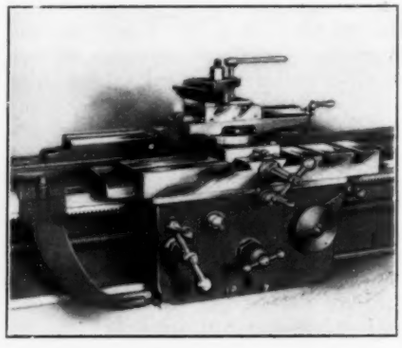


FIG. 9. A TOOL CLAMP.

The form of tool slide shown in Fig. 9 has been my favorite for years. It is not expensive. The nut on the central stud is made a finger fit, so that it is easily adjusted for different thicknesses of tools. Tightening the set-screw at the right by a part turn of the regular tool-post wrench puts the tool where it will stay, provided it is straight on the bottom. The top plate sits on three points—one at the set-screw, and the other two on the other corners on the tool. The chatter of a boring tool is customarily laid to its slimness. It probably is lucky that it is slim, so that it will spring itself instead of springing the tool-post and the cob-house it sets on. The amount of spring which is taken up by a tool-holder of the style of Fig. 9, is surprising to anyone at first sight.

THE CENTERS.

After we have done our best with all these slides, made our spindle larger and placed it in more rigid boxes, we still cannot compete on an engine lathe with any of the turret lathes equipped with fair tools. Why? Not altogether because the tools all remain set up, ready for use, on the turret lathe, but more because in an eingine lathe we depend on centers to carry the work. Did anyone ever stop to consider what an absurd thing it is to hang up work of any size on little angular center holes and then aggravate things by trying to take a chip off it? Think of hanging a thousand pounds on centers whose projected area does not exceed a quarter of a square inch. That is what we are doing every day, and it does not bother us half as much on so heavy a piece as it does on some lighter ones, for the heavy piece absorbs a good part of the vibration from the tool, so that the centers do not feel it. On a turret lathe there are no centers to hypnotize the lathe hand into thinking they are bearings. His work is

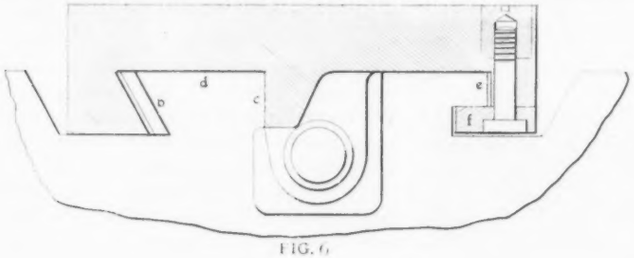


FIG. 6

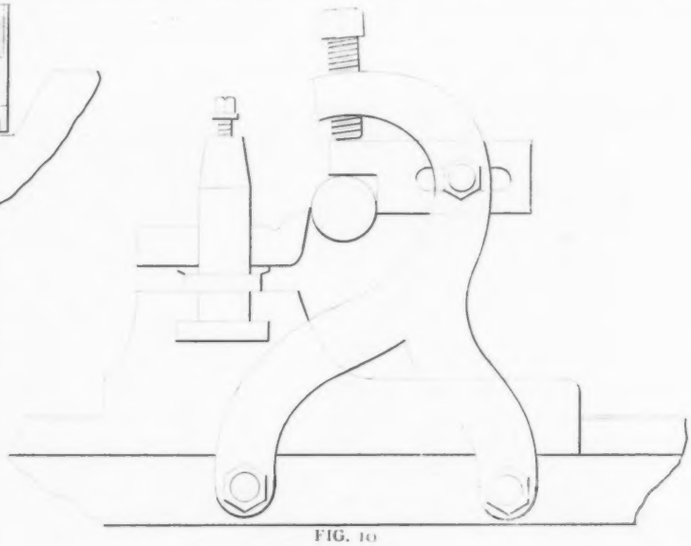


FIG. 10

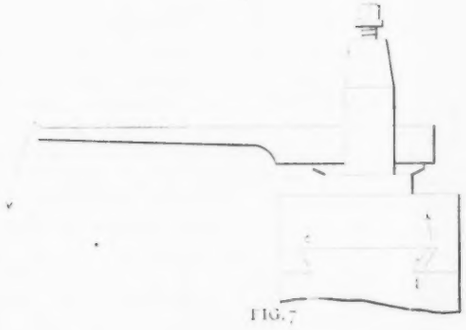


FIG. 7

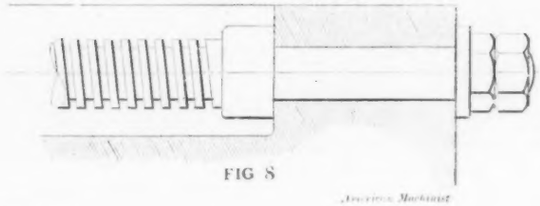


FIG 8

LATHE DETAILS.

held stiff at one end in a chuck, and at the other end he has to make a bearing to hold the work up to the tools, and that is the best feature of the machine.

CENTER AND FOLLOW RESTS.

The necessity for some additional support for the work has always been felt, though the spindling center rests and follow rests have been but little more than a mockery of what is necessary. The use of a follow rest for turning anything except straight shafting is in many shops practically unknown, and if all the follow rests were made like the first one that I used (shown in Fig. 10) there is no wonder that lathe hands do not take up with them. I have seen a good many follow rests, most of them little better than Fig. 10, but the best one of all has proved to be the one shown in Fig. 11. This fits across the wings of the carriage, and has quite a broad bearing on the carriage. It is set up close to the cross-slide, and is cut away at *c*, so that the compound rest can be turned lengthwise of the lathe. The upper jaw is set slightly in front of the vertical, so that by no possibility can the pressure of the tool throw the work out of place. The top and back jaws are held by binder-screws, as usual, and set up by set-screws, which are a finger fit, so that the pressure of the jaw on the work can be felt. We used the lower jaw only for long, slim work, which sagged perceptibly of its own weight, and then it was set up only by the lever *d* and weight *w*. This helped to stop any vibration set up in the work. This should be a great deal heavier than shown, and it would also be an improvement to bore out the hole in the rest true with the lathe centers, so as to use bushings to fit standard sizes of work, and also so as to use drills for chucking work. Another improvement that I would suggest would be the hinging of it at *g*, with a stop at *k*, to prevent its falling over back too far. If this rest is well made and in a convenient place, as it would be if hinged to the carriage, then the workman may be induced to use it; but so long as follow rests are such trappy contraptions, as most of them are, and they are kept stored away under piles of old waste and chips under benches, workmen never will have the patience to dig them out.

THE USE OF THE FOLLOW REST.

The use of a follow rest, say for such a piece as that shown in Fig. 12, is very simple. Suppose we have a dozen of them all cut off, centered and squared up. First turn a short space at the end of part *A* to the correct size, allowing for grinding. Set the two upper jaws down on this part by turning the screws with the fingers, tighten up the binder screws and go ahead.

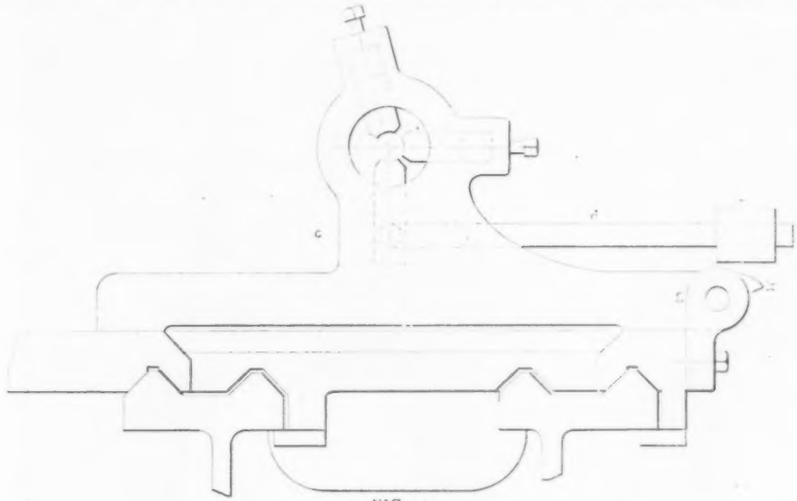


FIG. 11

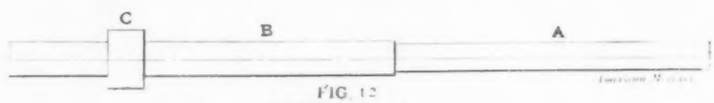


FIG. 12

LATHE DETAILS.

If the lower jaw is needed, which will only be the case with very slender work, put on the weight after starting up. While running up the cut, set the carriage stop, which all lathe builders will furnish if they have to to get the order, to turn to the first shoulder. Then run the carriage back a distance equal to that necessary to start the follow rest on to the work. Draw back the tool enough to turn part *B* to the correct diameter, either by aid of the cross-feed micrometer or by a positive stop on the rest. With the compound rest set parallel to the ways run the tool up far enough to begin to cut, throw in the power feed and turn up far enough to start the follow rest in. Do this, turning *A* and starting *B* for each of the twelve. By having an extra dog and changing dogs while running, this part of the work can be done as rapidly and as well as on any turret lathe. Then reset the follow rest to *B*, the carriage stop to the edge of collar *C* and go ahead with all the pieces. In this particular case it is best to leave the turning of *C* till *B* is done on all the pieces, and then set the follow rest on *B* back far enough from the tool so that the collar can be run across without hitting the rest. The other end of the shaft is turned the same as *A*, as it is easier than to set a center rest on *B*. This job may all be done without a special tool of any kind and, with a proper follow rest and favorable feeds and speeds, as quickly as on a turret lathe.

If lathe builders would only take some interest in rigging up their machines and the users were willing to spend half as much money for tools for lathes as they now do for heavy turret lathes, they might discover that the lathe is a long way from its ultimate best design. Of course there are large quantities of small work where the rapidity with which tools may be changed by revolving the turret is so great a factor that the engine lathe cannot possibly compete.

The Inventor of the Spinning Mule.

An illustrated article in the September number of the "Magazine of Commerce" tells the story of Samuel Crompton, the inventor of the spinning mule. Crompton was born at Firwood Fold, a suburb of Bolton, in 1753. His parents had a farm there, and in their spare hours carded, spun, and wove cotton. Crompton labored for years at his machine, and the dim lights in his garret at nightfall attracted public attention. Prying eyes climbed the trees near the Hall to watch his operations; more daring spirits found a way to his windows; while others scaled the roof —all with one determination, to filch his secret; for he had begun to turn out weft of such strength and fineness as was never before dreamed of. For this he could command his own price. The hand-spinners were up in arms, and threatened to smash the machine. When Crompton heard the wreckers in the neighborhood, he smartly took his mule to pieces, and hid it in a huge box in the garret. This he deftly covered over with the clay which composed the garret floor, so that the box had the appearance of a common earth heap. He saved his mule, set it up again, and spun in secret as aforetime. We have but one of Crompton's original mules remaining. This may be seen to-day at the Chadwick Museum, Bolton. It was probably made about 1780, and has in it the embodiment of the main features of the mule of to-day. Strange as it may seem, with all the enormous advances of mechanical science and its application during the past hundred years, the principles of Crompton's mule are as closely followed to-day as when his secret was divulged to the world. Crompton declined all offers of partnership, and failed to patent his in-

vention. He gave his mule to the world, and cotton-spinning in Lancashire was completely revolutionized. A subscription list was tardily built up, amounting in all to £67 6s. 6d. Many subscribers promised a guinea, but none paid more than 5s. 6d. He applied to Parliament for fair remuneration. His friend, John Brown, went to London to help him, but was so discomfited that he committed suicide at his lodgings. Crompton then traveled south, and himself sought help from the Commons. On May 11, 1812, Spencer Perceval, then Premier, was about to enter the House to plead for £10,000 for Crompton, when the pistol of the assassin, Bellingham, laid him low. Crompton eventually received £5,000, with which he resumed business at Darwen, and later at King street, Bolton.—*Engineer and Iron Trades Advertiser.*

The Transcontinental Passenger Association has issued a report showing the amount of passenger traffic business done in 90-day tickets for the Portland Exposition from April 10 to August 31. During that period 76,094 ninety-day tickets for Portland were sold at various Eastern railroad points. Of this number 47,113 tickets were validated in Portland, 18,749 in San Francisco, and 8,230 in Los Angeles. This report of the Transcontinental Passenger Association does not include the nine-months' tickets, of which there were a large number sold.—*Railway & Engineering Review.*

Recently Designed English Power Hack-Saws.

BY JAMES VOSE.

Since the—after the event—obvious notion of taking a suitably strengthened variation of the hand hack-saw frame, reciprocating it by power and feeding the blade by gravity into work held in a more or less—often, I fear, less—efficient vise, was first acted upon by some too-little remembered benefactor of mechanics, the idea has been exploited in diverse and sometimes fearsome fashion by a host of manufacturers. I am inclined to the belief that the simplicity of the functions of this useful tool, and the ease with which it could be, and was, "woven" at a low, though not necessarily cheap, selling price, has militated against its potentiality being realized. The small number of types of actual British manufacture have, I believe, received as much attention in the matter of general solidity of construction as has been compatible with market prices; but during the last year or two, a distinct tendency has been noticeable to first make a reasonably strong and accurate tool, and then offer it at an approximate figure. The notions of the British Government departments, as regards quality of equipment generally, have had some bearing in this connection. Several of the most recent productions in this line emanate from John Holroyd & Co., Ltd., Milnrow, Manchester, England, and, without any attempt on my part at comparison with other designs, the accompanying illustrations and details will probably be of interest.

Figs. 1 and 2 represent machines more particularly intended for cutting off disks and round bars up to 10 inches diameter; they are, I believe, the first *commercially offered* machines embodying the feature of revolving the work, with the object of expediting the cutting and obtaining true faces. Of course, here and there individual hack-saw users may probably have, to the same end, utilized improvised attachments to the ordinary hack-saw—one such device was illustrated in these pages a few years ago—but the above statement is broadly correct.

Fig. 1 illustrates the 5-inch machine,

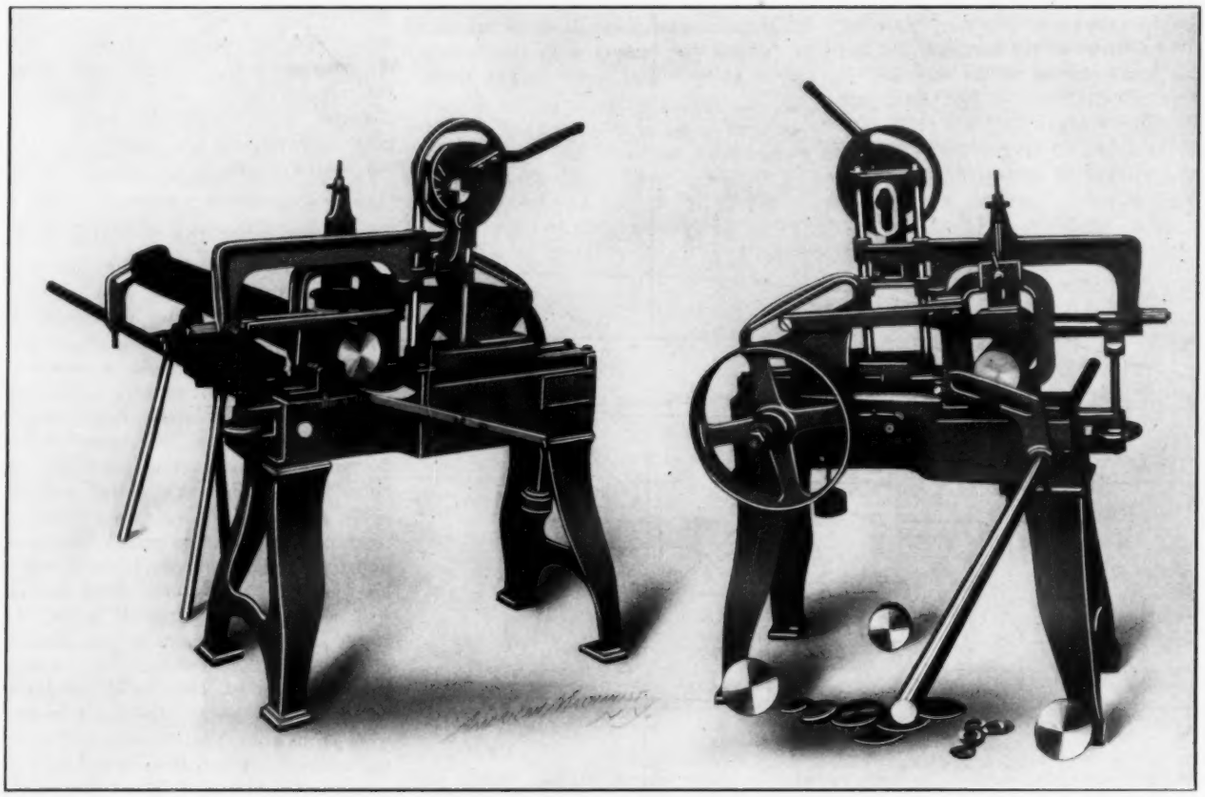


FIG. 1. ENGLISH POWER HACK-SAW FOR STOCK UP TO 5-INCH DIAMETER.

which weighs 400 pounds, occupies a floor space of 3x2 feet, has a stroke of 6 inches, and when cutting 5-inch blanks uses 14-inch saw blades. It consists of a body bolted on two strong standards; the body carries the reciprocating slide on two guide bars. The slide is driven by a crank from a 13½-inch pulley by a 2½-inch belt, the pulley being connected to the crank-shaft by a clutch which can be put in gear by a lever on the left-hand side, and out of gear by the lever and pan on the right-hand side of the machine. The saw frame is mounted on two upright guide bars, firmly bolted to the reciprocating slide and is fed down by the weight-cam on top. The frame can be easily raised by hand. On the bed, two adjustable roller brackets are bolted, on which the bar to be cut

revolves. A holding-down bar holds the bar firmly on the rollers, and a rocker with an adjustable pawl bracket rotates the bar. This rocker is driven by an inclined plate screwed to the reciprocating slide. A stand and pair of adjustable roller brackets for the support of long bars, end stops and extra pawl form part of the equipment of the machine.

The hack-saw in Fig. 2 weighs about 3,500 pounds, occupies 5x4 feet floor space, and uses 23-inch saw blades when cutting up to 10 inches diameter. The general design embraces a strong base on which are mounted two uprights, carrying the crossrail on which a slide is mounted, this in turn carrying the saw frame in a vertical slide. The horizontal slide is moved on the crossrail by a long connecting rod and crank and 4:1 gearing driven by a 14-inch pulley for a 3½-inch belt. It runs on rollers, and so works freely. The saw frame is balanced by an adjustable weight on a long lever, so that the pressure on the saw can be regulated. The saw blade is held in special grips at the ends of the saw frame. The bar to be cut rests on two roller brackets and is turned by a pawl fastened in a reciprocating frame, which is kept up to the bar by a balance weight, and is moved by a roller fastened to the horizontal slide running in an inclined slot which is part of the rocking frame. The bar is held down by a steel bar held in adjustable brackets. The rollers on the back support are set at an angle, and so the bar to be cut is forced back on a back stop. The front roller brackets are adjustable by screw and handle so that they can be quickly adjusted to suit different diameters.

Where large numbers of disks are needed, the small amount of waste involved in their cutting off by hack-saw methods is a somewhat important consideration. Within the last year Messrs. Holroyd have cut off 10,000 4-inch mild steel blanks. The saving of material under such conditions is very appreciable. On the 5-inch machine the cutting off of a 4-inch mild steel blank occupies from 18 to 35 minutes, according to the condition of the saw blades, and one blade usually cuts off between 15 and 20 blanks before needing sharpening. On the 10-inch machine, an 8 1-8 diameter mild-steel blank takes about 2 hours 7 minutes to cut off, and a 7-inch blank 1½ hours. These figures will probably be of service to readers collecting data on the by-no-means simple subject of the efficient and profitable cutting up of metals.

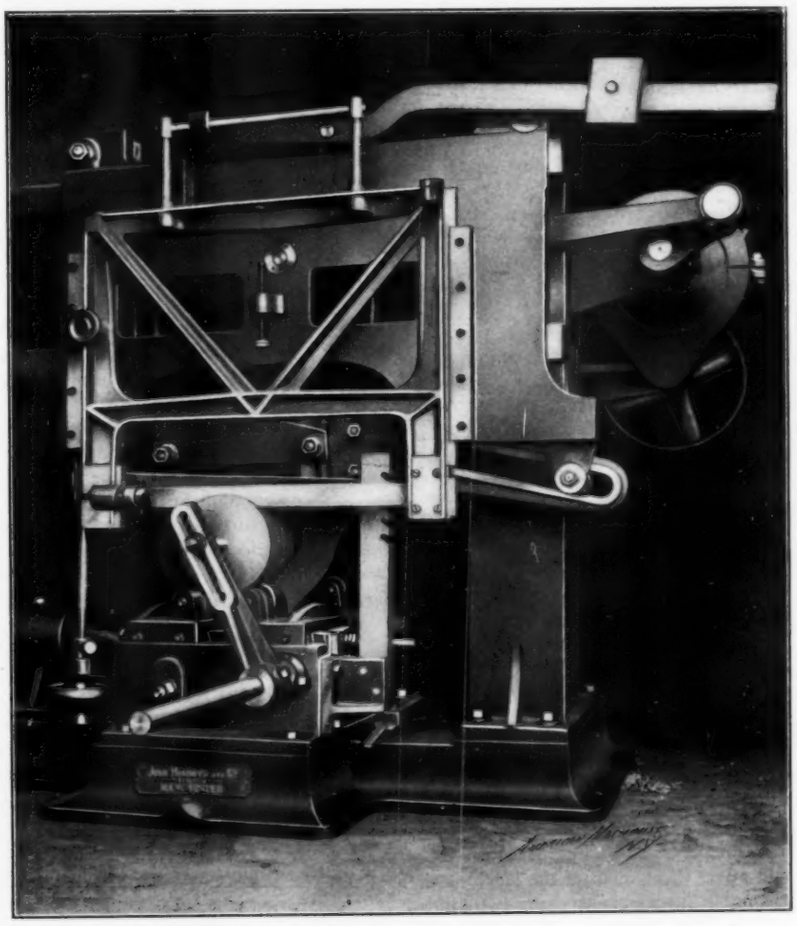


FIG. 2. ENGLISH POWER HACK-SAW FOR STOCK UP TO 10-INCH DIAMETER.

A Symboling System for Machine Parts.

BY W. BANCROFT.

In both the manufacture and marketing of standard machines, a flexible system of symboling the various parts that compose the machine is almost essential. Probably no completed machine has ever been built, for improvements in both design and shop methods are as much in the day's work as the booking of orders and the boxing of machines. It is therefore highly important that the symbols designating parts be absolutely flexible; that is, capable of extension in all directions. The system of symboling must also be simple; it may be possible in time to educate one's own employees to use a complicated system, but customers! Until machines are built both fool-proof and unwearable, repair parts will be called for and in a hurry too. A system that is simple enough to enable a customer to find quickly what he wants and order it so that his requisition cannot be misunderstood, does much to avoid adding the last straw to the load of his breakdown troubles. This last straw is the receipt of the wrong part.

A well known shop manager, whose memory runs back to the olden days when systems were not essential, to those rare old days when people were willing to wait, once said, "Unless a system works along the lines of least resistance it won't work long." Which is another way of saying that people are systematic only so long as it is easier to follow the system than not. In a system of symboling parts flexibility is therefore placed first in importance, for unless a system provides for all possible changes, no matter how simple it may have been, it will not long retain the charm of simplicity.

The following method of symboling parts was devised by the Monotype Company to designate the parts of its type-casting and composing machine. This machine contains 1,062 different kinds of parts and 2,028 in all. The machines are built in large quantities and their parts are, of course, interchangeable. In accordance with the best practice, the machine is divided into several sections called groups; each distinct function is performed by one of these groups. The machine is so designed that these groups may be fitted up complete, drawn from stock as required, and bolted to the bases of machines, just as planer crossheads and driving gears are built in quantities and attached to the beds as ordered.

INDICATING THE GROUP AS WELL AS THE PARTS BELONGING TO IT.

Since each group is really a separate machine, it is desirable that the symbol of a piece indicate the group of which it is a part, and this can best be accomplished by designating the piece by a combination of

numbers with a letter. The letter indicates the group to which the part belongs; thus the *Bridge*, or *Matrix Carrying Mechanism* is known as the A group, and the *Bridge* being the first piece, in alphabetical arrangement, in this group is 1A. H group designates the *Pump* mechanism, and the *Pump Body* is symboled 23H.

Extending the group system still further, it is desirable that minor pieces in a group be related to the major pieces which they compose. Thus, in the case of the *Bridge* two of its *Legs* are cast in place, the third, for constructive reasons, is bolted to it. This loose piece is known as the *Bridge Leg*, and its symbol 1A2 states this fact as clearly as its name *Bridge Leg* conveys the idea that it is a leg associated with the *Bridge*. The letter indicates the group of the machine to which the piece belongs, the number at the left of the group letter the section of the group, and the number at the right the particular piece of this section.

The *Bridge* is made up of the following pieces:

A GROUP.

BRIDGE	1..	1A
screw (2)	24	1A1
leg	1..	1A2
" screw (side) (2)	222 (*1*)..	1A3
" " (top)	228 (*1*)..	1A4
" spring post for Fibres Stop Spring	.....	1A5
guide rod bushing (2)	.....	1A6
" " " nut (2)	.....	1A7
" " " adjusting screw (front)		1A8
" " " adjusting screw (rear).		1A9
pin for Fiber Stop	.....	1A10
BRIDGE 1A (complete)	.....	
Bridge-centering-pin-stand Adjusting Screw, see Centering-pin-stand Adjusting Screw	.....	6A1

The *Bridge* complete—that is, all the above parts from 1A to 1A10, inclusive, assembled ready for the machine—is known as 1A (complete). Thus, if a customer wants all of the above parts fitted up, he orders *Bridge* 1A (complete).

In a list which goes to the customer it is necessary to designate pieces that cannot be furnished without other pieces. For example, the *Bridge* 1A cannot be furnished without the *Bridge* Leg 1A2 and the *Screws* 1A3 and 1A4 that hold the *Leg* to the *Bridge*, for this is a most accurate part of the machine and the *Bridge* is ground after the *Leg* is bolted to it. It is therefore necessary to indicate that neither the *Bridge* nor its *Leg* can be furnished without the four pieces 1A, 1A2, 1A3 and 1A4. Of course the *Screws* 1A3 and 1A4 can be furnished without either the *Bridge* or its *Leg*.

The relation between the above pieces is indicated by printing on the same line with the *Bridge* 1A and its *Leg* 1A2, a roman figure I and on the line with the *Screws* 1A3 and 1A4 an italic I in parentheses, (*I*). If either of the pieces marked with a roman I be called for, all pieces numbered I must be ordered. Pieces marked with the italic I, however, may be ordered the same as pieces not marked.

Occasionally a combination of parts contains two sets of pieces that cannot be ordered separately. The first set is designated by the number 1, as above, and the second by the number 2. For example:

GALLEY CAM	1..	14F
driving pawl	.....	14F1
" " (pin for Spring)	(2)..	14F2
" " fulcrum screw	.....	14F3
" " fulcrum screw (washer)	47....	14F4
driving pawl spring	646....	14F5
" " " post	.....	14F6
" " stop pin	(*1*)..	14F7
sleeve	.....	14F8
GALLEY CAM 14 F (complete)	.....	

The *Galley Cam* 14F cannot be furnished without the *Stop Pin* 14F7 for the *Driving Pawl* 14F1, neither can the *Pawl* be furnished without its *Spring Pin* 14F2, for both *Pins* are forcing fits in the pieces that carry them. This is shown by the numbers 1 and 2, respectively, after the names of the pieces that cannot be furnished separately. Since, however, the *Pins* can be furnished without the pieces that carry them, the numbers following the *Pins* are printed in italic and placed in parentheses.

Ample cross references are provided. To return to the *Bridge* 1A, it carries two adjusting screws for positioning the *Centering-pin Bushing* 6A. The function of these screws is to position the *Bushing*, and this is shown by their symbol 6A1. A person not familiar with the machine might suppose that these were part of the *Bridge* 1A. To avoid this confusion the following note, in italic, is printed immediately below the 1A group:

Bridge - centering - pin - stand Adjusting Screw, see Centering-pin-stand Adjusting Screw——6A1.

TAKING CARE OF ALTERATIONS.

So much for the system before alterations take place; to be effective it must be just as simple after alterations have been made. Changes in pieces are of two kinds: first, those that effect the interchangeability of the particular piece altered, or of parts related to it, and second, those that do not. The latter are properly not alterations. For example, suppose the curve of the *Galley Cam* 14F be altered but that the new *Cam* can be supplied to all machines without any alterations whatever. Obviously this is not a change that should affect the symbol of the piece, since it will not be necessary to carry two kinds of *Galley Cams* in stock. Either the old *Cams* will be scrapped or they will be used up and no more of that kind made. In the latter case the old stock should be used before any of the new is issued. The new *Cams* should therefore not be put with the old in the storeroom, but a tag should be placed on the old pieces, giving the location of the new lot and stating that this new lot must not be issued until the old lot is exhausted.

When, however, the alteration affects the interchangeability of the piece the symbol must be altered, since different kinds of these pieces must be carried (to avoid errors in shipments, the two kinds of the same part should be kept in different sections of the store room). Alterations of this character are designated by prefixing for the first alteration a lower-case a to the symbol of the piece altered; for the second change the a is replaced by b, and so on through the alphabet. The twenty-seventh alteration to the *Bridge*, which exhausts the alphabet, would be designated by aa1A; the twenty-eighth by ab1A. Since, however, the highest alteration letter now used by the Monotype Company is d, it is probable that the combination of alteration letters will not be required.

The following example illustrates this method of symbolizing:

LOCKING-BAR CONNECTING ROD	.....	33E
bearing block	.....	a33E1
" " lock nut	316....	a33E2
" " plate (discarded)		
" " rivet (discarded)		
eye	.....	a33E5
" lock nut (L H.)	317....	a33F6
spring	667....	a33E7
LOCKING-BAR CONNECTING ROD a33E (complete)		

This combination of parts is printed just as it was before any alterations were made, with the following modifications: Since the *Bearing-block Plate* and its *Rivets* are no longer used, the word (discarded) is printed after these parts and their symbols, 33E3 and 33E4, are omitted. A lower-case a is prefixed to the symbols of the altered pieces. It will be noted that although the *Locking-bar Connecting Rod* 33E is not altered, the symbol of this part complete, of course, bears the lower-case a and is written thus, LOCKING-BAR CONNECTING ROD a33E (complete), since some of the pieces composing this combination are altered.

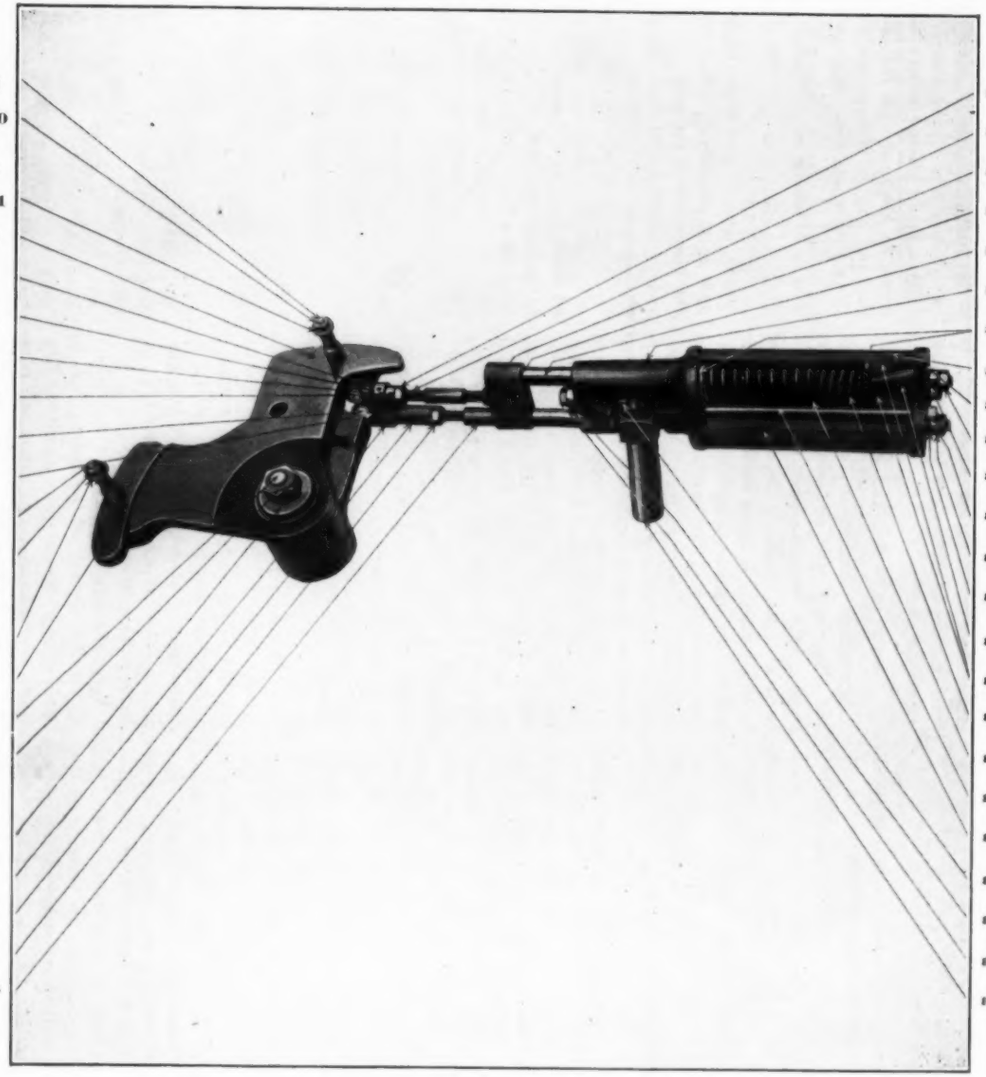
In case a future alteration of this combination introduced new pieces, the discarded symbols 33E3 and 33E4 would be used again, modified by the letter a.

DESIGNATING NEW COMBINATIONS.

For convenience in finding, all combinations bearing the same group letter are arranged alphabetically, and when the list of parts was first made out the numbers at the left of the group letter followed consecutively. The introduction of new combinations changes this; a new combination must take for its number, at the left of the group letter, the next number above the last in the group. Thus, as originally built, the *Locking-bar Bell Cranks* (lower) 28E and (upper) 29E did not have *Latches*. When these were introduced the symbols were altered as follows:

LOCKING-BAR BELL CRANK (lower, for rear Bar)	1..	a28E
spring post 78	(*1*)..	a28E1
fulcrum pin for Latch 795	(*1*)..	a28E2
LOCKING-BAR BELL CRANK a28E (complete)		
LOCKING-BAR BELL CRANK (upper, for front Bar)	1..	a29E
spring post 78	(*1*)..	a29E1
fulcrum pin for Latch 795	(*1*)..	a29E2
LOCKING-BAR BELL CRANK a29E (complete)		
LOCKING-BAR-BELL-CRANK LATCH (lower)	1 .	a82E
spring pin	(*1*)..	a82F1
LOCKING-BAR-BELL-CRANK LATCH a82E (complete)		
LOCKING-BAR-BELL-CRANK LATCH (upper)	1..	a83E
spring pin	(*1*)..	a83E1
LOCKING-BAR-BELL-CRANK LATCH a83E (complete)		

Jaw Tongs Bell Crank Stud	a21E2
Jaw Tongs Bell Crank Stud Nut (upper)	a21E10
Jaw Tongs Bell Crank Stud Nut (lower) (not shown)	a21E9
Jaw Tongs Bell Crank Stud Washer	a21E11
Jaw Tongs Bell Crank (upper)	a21E6
Jaw Tongs Spring Box Ball Socket (upper)	a81E
Jaw Tongs Spring Box Ball Socket Lock Nut (upper)	a81E1
Jaw Tongs Spring Box Ball Socket Plug	a81E2
Jaw Tongs Bell Crank Ball Stud	a21E7
Jaw Tongs Bell Crank Ball Stud (lower)	a21E1
Jaw Tongs Spring Box Ball Socket (lower)	a27E
Jaw Tongs Bell Crank Stud	a21E2
Jaw Tongs Bell Crank Stud Nut (upper)	a21E4
Jaw Tongs Bell Crank Stud Nut (lower) (not shown)	a21E3
Jaw Tongs Bell Crank Stud Washer	a21E5
Jaw Tongs Bell Crank (lower)	a21E
Jaw Tongs Bell Crank Stud	a22E
Jaw Tongs Bell Crank Stud Nut	a22E2
Jaw Tongs Bell Crank Stud Nut (lower) (not shown)	a22E1
Jaw Tongs Bell Crank Stud Washer	a22E3
Jaw Tongs Spring Box Ball Socket Lock Nut	a27E1
Jaw Tongs Spring Box Ball Socket Plug	a27E2
Jaw Tongs Spring Box Ball Socket Plug Lock Nut	a27E3
Jaw Tongs Spring Box Spring Rod	26E14



a26E24	Jaw Tongs Spring Box Connecting Rod Lock Nut (L H.)
a26E22	Jaw Tongs Spring Box Connecting Rod
a26E23	Jaw Tongs Spring Box Connecting Rod Lock Nut
a26E21	Jaw Tongs Spring Box Spring Rod Crosshead
a26E17	Jaw Tongs Spring Box Spring Rod (upper)
a26E25	Jaw Tongs Spring Box Tube Cap
a26E11	Jaw Tongs Spring Box Spring Abutment (4)
a26E24	Jaw Tongs Spring Box Tube (2)
a26E28	Jaw Tongs Spring Box Tube Plate
a26E20	Jaw Tongs Spring Box Spring Rod Nut Lock Nut
a26E19	Jaw Tongs Spring Box Spring Rod Nut
a26E27	Jaw Tongs Spring Box Tube Clamp Stud Nut (2)
a26E16	Jaw Tongs Spring Box Spring Rod Nut Lock Nut
a26E19	Jaw Tongs Spring Box Spring Rod Nut
a26E13	Jaw Tongs Spring Box Spring Brake Cone (2)
a26E12	Jaw Tongs Spring Box Spring Brake (wood) (2)
a26E10	Jaw Tongs Spring Box Spring (outside) (2)
a26E9	Jaw Tongs Spring Box Spring (inside) (2)
a26E26	Jaw Tongs Spring Box Tube Clamp Stud (2)
a26E24	Jaw Tongs Spring Box Tube (2)
a26E6	Jaw Tongs Spring Box Ball Plug (right bearing for Ball)
a26E5	Jaw Tongs Spring Box Ball Plug Button
a26E7	Jaw Tongs Spring Box Ball Plug Nut
a26E1	Jaw Tongs Spring Box Ball Extension

A SYMBOLING SYSTEM.

It will be noted that the symbols of the new pieces introduced, the *Latches,* a82E and a83E, are modified by the lower case a, for these pieces are alterations. To guide those who know the symbol of the piece and desire to find its name, a cross reference is made opposite this number in its consecutive position on the list. Thus the following list of new pieces introduced is printed at the end of the E group:

Jaw-tongs-spring-box Ball Socket (upper) a81E
Locking-bar-bell-crank Latch (lower) a82E
Locking-bar-bell-crank Latch (upper) a83E
Locking-bar-bell-crank-latch Spring a84E
Locking-bar-bell-crank-latch Spring Post a85E
Locking-bar Cam a86E

This also shows the next consecutive number not appropriated when a later alteration introduces new parts; for example, the next new part introduced in the E group would be symboled a87E.

SYMBOLS FOR PARTS USED IN TWO OR MORE SECTIONS OF A MACHINE.

It is obvious that in any machine the same piece is often used in two or more parts of the machine. Thus, the Monotype Casting Machine contains 966 duplicate parts; for example, to return to the *Bridge* 1A. The *Bridge Screws* 1A1 are standard and are used in several places. Just here arises an important difference that should be fully provided for in a system of symboling. To the shop manufacturing these parts it is a matter of considerable moment that the same part is used in two or more sections of the machine. To the customer, however, ordering a repair part this has no interest whatever; he wants a *Bridge Screw* 1A1 and he cares not a jot for the fact that this *Screw* is also used for the *Galley-pan-shelf Screw* 17F5, although this is of the highest importance to the shop.

Pieces that are used in two or more sections of the machine have no group identity in the shop, and therefore have no group letter, but are designated by numbers. The *Bridge Screw* is known in the shop as No. 24. This number is printed on the same line with its symbol 1A1 in the lists used by the employees, but to avoid confusion is omitted from the price lists furnished to customers. Note: all of the above examples are taken from the list of parts used by employees and consequently show the bold-face numbers, which would be omitted from the price lists.

These manufacturing numbers, *i. e.,* the numbers by which pieces used in different places are known, also designate the character of the piece. Thus the digit 2 of the number 24 shows that the piece is a screw. The 4 is the number of this particular screw on the screw list. This system is absolutely flexible; no matter how many different screws may be made, it is not possible to run out of numbers. The first screw on the list is 21; the seventeen-thousandth, when we get that far, will be 217000. The digits 1 to 9 are used to indicate the different kinds of duplicate parts as follows:

Bolts 1
Screws 2
Nuts 3
Washers 4
Dowels 5
Springs 6
Miscellaneous parts, bushings, spring posts, etc. 7
Wrenches 8
Cotters 9

The Monotype Company has found that the above division of duplicate parts meets all its requirements, but should it be desirable to indicate a new section in the list of manufactured parts these new parts would be indicated by 01. The next section introduced would be 02, etc.

The company supplements its price list with very complete photographs of the various parts of its machines. These do not show the parts separately, which makes their identification difficult, but in their relation to other parts as in the illustration herewith.

SHOP DRAWINGS AND PRINTS.

A word in reference to shop drawings and blueprints. But one piece should be shown on a drawing, and these should be small (the standard size of those used by this company is 5½x8 inches), both for convenience and for clearness, for, speaking within limits, the smaller a drawing is the more easily it is read. With a system of individual drawings for separate pieces the drawing bears the same symbol as the piece, and this symbol is changed just as the piece symbol changes. When the change is not too great the tracing itself is altered, and a blueprint of the tracing before alteration is filed for record. When the change requires a new tracing the old tracing goes into the record file.

Our own efforts to apply bodily to the needs of our business systems that have been most successful in other plants convince us fully that no system is a universal panacea, but that all must be modified to suit the particular needs of each business. We have, however, found the above system so helpful to us in rapidly and accurately filling orders, that we submit it in the hope that it may be as helpful to other readers of the AMERICAN MACHINIST as some of the systems already described there have been to us.

We make no claim whatever to originality in this system of symboling, but its application of the old principle of the flexibility of combinations of letters and numbers is, we think, new.

It is stated that the new harbor works at Antwerp, Belgium, which are mentioned in the article on the Liège Exposition at page 351, are to cost $36,000,000. The state will bear $20,200,000 of the expense. In the neighborhood of $130,000 will be expended by the Ministry of Public Works for harbor improvements in Blankenberghe.

R. D. Nuttall, of Pittsburg, is cutting a gear some 18 feet in diameter and 30-inch face, weighing 30 tons. They think this is record gear cutting.

Letters to the Editor.

Bevel Gear Formulas.

At page 435 Mr. Fish criticizes my article on "Bevel Gear Formulas" as being incomplete in the treatment of cases where shafts are not at right angles.

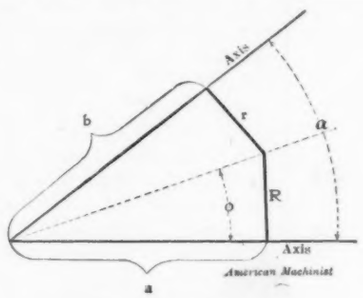
He says, "The way this problem usually confronts a designer is with the angle between the shafts given and either the velocity ratio given or the diameters of the two gears." If he will examine formulas (21) and (23) of the article in question he will find that they require *just this and nothing more* in order to solve for the angle ϕ.

On further examination of the article he will find that his solution for the first case—that of shafts at less than 90 degrees—is identical with the one given by me, and had he reduced his formula still further he would have obtained as a result:

$$\tan.\ \phi = \frac{\sin.\ \alpha}{\frac{r}{R} + \cos.\ \alpha}$$

where, when r and R are radii of pinion and gear respectively, ϕ is the angle of the pitch cone of the gear.

In practice I prefer to use the number



THE BEVEL-GEAR PROBLEM.

of teeth in the gears, since this does away with complications due to fractional dimensions.

In regard to his solution for the case with shafts greater than 90 degrees (and less than 180 degrees) I have nothing to say, except that in deriving formulas (21) and (23) as given in my "Bevel Gear Formulas" article I obtained a variety of different formulas some "most a yard long" and impossibly complicated, making it necessary to resort to the tenth decimal place in order to get accurate results. I think that on second thought Mr. Fish will concede that formula (23) will answer all needs so far as the conditions he has named are concerned, and that it is much simpler and more easily applied than the formula he gives.

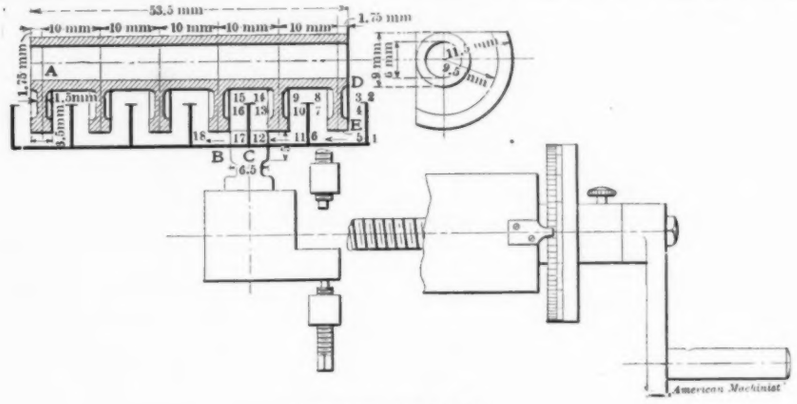
The way the problem usually presents itself in practice is illustrated in the sketch. It is generally required to connect two shafts at an angle a with each other with bevel gears of a certain ratio, the distance c or b from the intersection of the shaft centers being given and the diameter of the gears being dependent on these conditions.

The first thing to do in this case is to solve for ϕ, which being found R is seen to be equal to $a \times \tan. \phi$. The radius of the other gear is easily found from the ratio of the gearing to be used.

JOHN EDGAR.

Machining Galalith.

The piece shown at *A*, which is a part of a small electrical apparatus, caused considerable perplexity in deciding upon a suitable method of machining, until the following was hit upon:



MACHINING GALALITH.

The material, Galalith, allowed the grooves to be turned from the solid by the forming tool *B*, which, by means of the stops on the cross-slide and a micrometer collar on the lead screw, performed the work without calipering and in very satisfactory time. The center *C*, of the tool, may be considered to travel in the path indicated by the heavy line, occupying the different positions in the order of the consecutive numbers.

It is doubtful if a piece of the same form could be produced in metal by this method, as the arbor is long and slender, while the width of cut is considerable. This material is so soft that the tool turned up a broad ribbon with very little trouble from chattering. As perhaps Galalith may not be well known, it being, I believe, a recent product here in Germany, at least in commercial sizes, it may be well to describe it.

It is said to be made from casein or cheese, and to have the same chemical composition as horn. When worked at high speed, the odor of hot iron in contact with hoofs is very strong. It is a substitute for hard rubber in electrical work, although said to be inferior to rubber in insulating properties, but apparently much superior in strength and ability to keep its shape under changing conditions of temperature, etc. As far as could be judged, it possesses no grain and the webs in the work were strong enough to resist a strong lateral pressure with the thumb, it being almost impossible to break them in this way. The price, here in Berlin, is about the same as that of hard rubber, and it can be obtained in a variety of colors (red, black, etc.), but only up to 25 millimeters in diameter for rods and about 15 millimeters thickness for sheets. While rubber chips are marketable for reworking, Galalith chips are usable only for fertilizer.

The rough blocks were finished in the bore, the ends faced the proper length, and a roughing cut taken over them. They were then placed in the lathe, upon an arbor which, being draw-filed lengthwise, seemed to give a better grip than if smooth. The tool with the stops upon the cross-side already set and the tool-block against the forward one, was then adjusted so as to just scrape the right-hand end *D* of the work (position 2). The micrometer collar upon the lead-screw being then set to zero, the tool was fed in from position 2 to 3, then withdrawn to 4 and the tool-block brought against the rear stop on the cross-slide (position 5) and the carriage fed along to the position for the first groove (position 6), finishing the surface *E*. The radius of this surface, it may be said, was the only important dimension on the piece, the grooves being provided only to lighten it, in appearance as much as actually, although the latter was of considerable importance. The micrometer collar was used to determine the spacing of the grooves as well as the depth of the recesses on each side. In this case the spacing being 10 millimeters and the pitch of the lead screw 5 millimeters, it required only two complete turns of the collar for the spacing, allowing the same readings each side of zero to be used for each groove to obtain the proper depth of the recesses.

As it was impossible to take up the lost motion in the lead-screw, trial was made to obtain its amount, which was added to the micrometer reading when feeding the tool from position 7 to 8 and from 13 to 14, etc. As the web thickness did not have to be exact, this gave good results, and with care the variation ought to be no more than one or two tenths of a millimeter. The operation for each groove, as outlined, was repeated in succession for each until the piece was complete. The material allowed the tool to be fed almost as fast as it was convenient to operate the feed screws by hand, and the time averaged about 10 minutes for each, starting from the roughed block. It was necessary to grind the tool only two or three times in turning 100 pieces, this being less than would have been necessary with hard rubber.

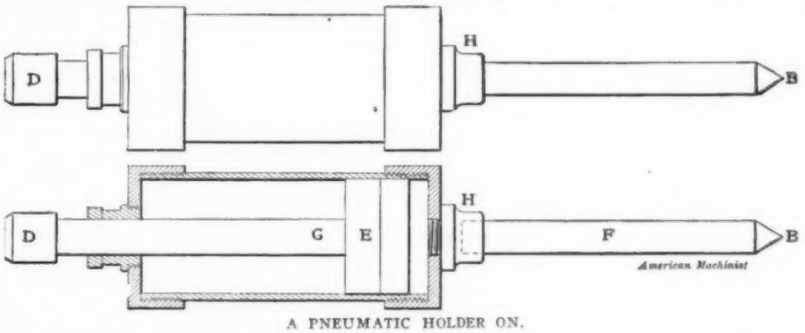
Instead of spacing by the lead-crew, as described, it was planned at first to lay a steel scale on the lathe bed so that it would be pushed along by the carriage and to read the spacing by means of the scale from a stationary mark on the bed. Of course in this case the compound rest or other means must be used for feeding each way into the recesses. With a little care this would have been accurate enough for the requirements.

H. L. WHITTEMORE.

Charlottenburg, Germany.

A Pneumatic Holder On.

The accompanying drawing shows a new device for holding rivets in place while they are being headed over by hand. It is used inside the shell of a boiler, the point *B* resting against the boiler while *D* is forced against the head of the rivet by means of air pressure acting against the piston *E*.



A PNEUMATIC HOLDER ON.

The construction of this "holder on" is very simple. The body of the air cylinder is a piece of 4-inch pipe, finished on the inside to a diameter of 4⅛ inches. The piston is attached to the rod *DG*, which is about 13 inches long. The rod *F* is made in several lengths, each being interchangeable with very little loss of time, as they are screwed loosely into the plug *H*.

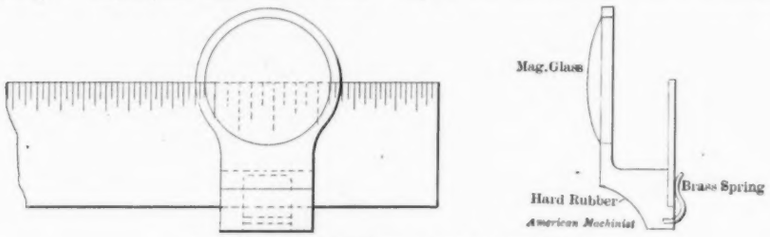
This "holder on" has been in use for

some time at the Atchison, Topeka & Santa Fé boiler shops at San Bernardino, Cal., and has been proved to be very satisfactory in every way, being a marked improvement over the old method of using a sledge and sling for this work.

G. E. B.

Holding a Magnifying Glass on a Scale.

The sketch shows an attachment for holding a magnifying glass on a scale,



HOLDING A MAGNIFYING GLASS ON A SCALE.

the flat brass spring at the bottom keeping the holder at any point desired along the scale

CHAS. SEHL.

Three Ways of Molding a Piston Head.

A gas-engine piston head seems to be a very simple thing, that is, one of the trunk type (like the sketch) that is a little more than twice as long as the diameter. I do not know who did the planning of the first ones that the foundry made, but they were made with the open end down. This was a very easy way to make them, as the pattern could be drawn out and the core stood down into a taper print that guided it right to place.

I do not know that this method would ever have been changed if time had not revealed some defects that came from this way of doing things. If there was any dirt of any kind in the mold, of course it could always be found in the top end of the head as cast, and unfortunately this end was also the end that had to stand the heat and the effect of the explosion, and so could least afford to be defective in any way. It also seemed as if blow holes had a special liking for the space that should be occupied by spaces for the rings, when it was most desirable to have perfect sides on these same grooves. If the defects in these heads could have been always discovered before any work was done on them it would not have been quite as bad, but it was very seldom that any defect showed up until the grooves were being finished, and by that time nearly all of the work was done on the head, and worse than that was any dirt in the end of the head, as it might not show up until the engine was on the testing block and subjected to the heat.

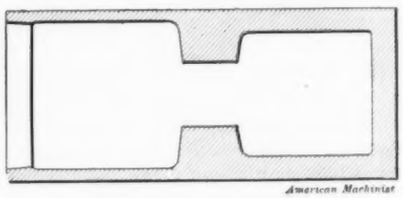
A consideration of these things led the foundry foreman (he was not the one who was in charge when the first heads had been made) to change the way of making them. He did them the other way up. Instead of setting the core down in the mold he hung it up, and if there was any dirt in the head it was in the open end.

This was an improvement in many ways, but it still had some drawbacks, for while there were not so many bad heads in the machine shop, neither was it possible for a man to make one in the foundry in the same time that he could in the old way. In making them in the improved way it was necessary to use a three-part flask with one of the partings at each end of the head. This brought the core print in the cope, and it was necessary to tie the core up in it with wires. After it was made secure the cope was put onto the cheek, and then a man got down in under with a pair of calipers and proceeded to center the core. This he did by pushing in one or other of the several wedges that went through loops in the various wires that were bedded into the print end of the core. After he had the core centered to his satisfaction, the cope and cheek were lifted onto the drag. If the core did not move during this last operation, he might get a casting that was all right, but it was soon found that if the centering and wedging were not carefully done the core would be lop-sided and would have to be thrown away. If there were any bad spots in the head, they would usually be found at the open end, and they could often be gotten rid of by cutting back a little; but if they ran in too far to be cut out, the head would have to be thrown away, for while they might not do any harm they were in the place in the head where they were the most conspicuous when the head was in use.

Owing to the fact that it was a job of considerable skill to center and secure the core in a reasonable time and with certainty, the work on these heads had to be given to a good man, and good men come high; so all things considered the heads were an expensive job and also one that was not liked by the men. Because of the known difficulty of centering the core accurately, the machinists had to center the heads by the core instead of by the outside; and so an extra amount of finish had to be on the pattern so as to have enough to allow them to true up. An extra eighth of an inch all around on a head as long as these means quite a lot of iron, and it takes an extra cut to get it off, or if it is taken off at one cut the feed will be finer; but above all of these things was the necessity of getting good heads, and this method seemed to be the best way to get them. After a while there was a new man in charge of the foundry, and while he was a modest man and did not put up any claim of being smarter than his predecessors, he had different ideas on some things, and was willing to try to live up to his previous experiences and knowledge; and in trying to make things go as well as he could in his end of the establishment, this head job was one of the things that struck him as having in it all the elements for improvement on some of the sizes.

After looking at the matter from various sides, a pattern was made that would do for two heads. A long piece was turned up that was the size of a head at each end, and a liberal space was left between them for core print. This pattern was parted lengthways through the center. The core box was made so as to make the core for both heads in one piece.

With this arrangement it was thought that two heads could be molded almost as quickly as one, and much more quickly than one could be in the old way. After



TRUNK PISTON HEAD.

a few heads had been made, it was found that the new way had some drawbacks. In spite of a long print between the two heads, it was found that the core would rise, and it was apt to rise more on one end than on the other, although the mold was poured from both ends at the same time. To counteract the tendency to tip, the print was made longer, and chaplets were used to hold the core down, so as to offset the desire it had to float.

This being a new way to do this job, it was watched closely for a time, and everything seemed to be all right and so easy that it seemed as though almost any molder could be sure of good heads, and, as is usual, the attention was shifted to some other part of the foundry work.

About this time the man in the machine shop thought his method of centering the heads could be bettered, and he changed it so that he was sure when he got through that they were really centered by the core; and about the time he had his changes finished, it was found that more heads were being thrown out because of the core not being centered properly than was pleasant. In making the pattern for the new way of doing the heads, the finish had been reduced so that it was not much more than it would have been if it had not been necessary to pay any attention

to the core. This had been done because the boss molder said that it was as much as he would need, but it did look almost as though he had been mistaken; however, he did not lose his nerve and give up, but he had a little gage made so that the molder could try it and make sure he had the core clear down in the print before putting on the cope. He also had one made so that the ends of the core could be tried to see that it was not nearer to one end than the other. By these means he has succeeded in getting good heads without having excessive finish on them. WILBER.

Notes on Machine Tools—Shaped Cutters in Small-Arms Manufacture—The Blanchard Lathe.

At page 1704, Vol. 27, Part 2, among other things which are usually wrong Professor Sweet mentioned the shaper crank. With all due respect to such an authority, I would suggest that he has not exhausted the subject, especially as the shaper is made in America. Figs. 1 and 2 show the usual form of crank and an improvement thereon. By the way, this improvement is not new, cranks have so been made by at least one English firm for about forty years. Cranks made as shown in Fig. 2 give a more even stroke thar those shown in Fig. 1. Another decided advantage is that the bearing *B* is better adapted to heavy pressures than the rocker joint *C* of Fig. 1.

Vertical milling-machine spindles generally rotate in an anticlockwise direction. Many English horizontal millers have their feed so arranged that the spindle can only revolve clockwise. Why? The only apparent result is to prevent screwed cutters being interchangeable.

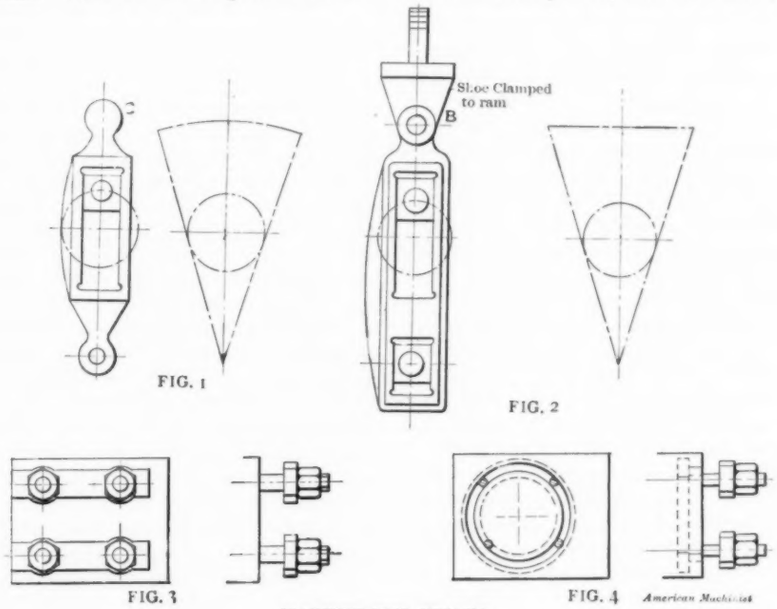
From time immemorial, the top rests of English lathes have been made with two tool-dogs and four stationary bolts, as shown in Fig. 3. While these give very strong clamping, the tool has not the adjustability, in a horizontal plane, of the American top rest; in fact, there are really only two positions for the tool—parallel with and perpendicular to the center line of the lathe. A rest made as shown in Fig. 4, having a circular T-slot, using ordinary bolts and dogs, would seem to have the flexibity of the American rest, with the necessary—in view of the high-speed steels—strength of the English method.

There was recently some correspondence in the AMERICAN MACHINIST about the method of grinding shaped cutters at the Rock Island Arsenal. It struck me as decidedly strange that a similar system of cutters should be in operation at the English rifle factory at Enfield. When in other kinds of interchangeable manufacture the formed style of cutter is almost universally used, how is it that two factories, far apart, belonging to different governments, have both in operation a system that has long been regarded as out of date? Insular prejudice? Or is there something in rifle manufacture that really demands it?

One of the most interesting, at least to me, of the many illustrations shown in connection with the description of Rock Island Arsenal was Fig. 47, at page 313, Vol. 28, Part 1. It shows part of the stocking shop. The interest lies in the butt turning machines which form the prime part of the view.

About 1850 a complete plant for the manufacture of stocks, handguards, etc., was sent over to England. They bore the name of Ames Manufacturing Company, of Chicopee, Mass. They were, I think, first shown at an exhibition, afterward being bought by the English Government and installed in the English factory. The majority of the machines are working now and are practically as good as ever. The reason for taking some of the machines off the active list is that the stock has been altered, the butt and the fore end now being separate. The gray iron seems to be of exceptionally good character. Some spindles revolving 6,000 revolutions per minute have cone bearings in that metal and have never been rebedded, and the slides are in a similar good condition. It is interesting to note that the machine in the foreground of Fig. 47, though comparatively new, looks like a replica of one of the machines at Enfield, even down to such details as the flat spring and reversing lever for the traversing screw. These facts speak most highly for the design and manufacture of the original machines. H. T. MILLAR.

Manchester, England.



MACHINE-TOOL DETAILS.

Valve Suggestions.

Having at various times had a deal of trouble with valves of various descriptions, I should like to offer a few practical suggestions.

It is a common practice in an all-brass valve of the globe type to make both body of valve from the same mixture of metal, the seat and valve thus being of equal hardness. Easy as it is to refit the valve to the seat, it is more difficult to reseat the chest, calling, as it does, for special tools not always available. If a miter valve is taken out after the first screwing down on the seat, a ring formed by the compression is seen on the machined face of the valve, which becomes deeper with further use. When overhauling the prominent metal left can easily be removed with a file, and the valve lightly ground to a fit. If the seat and valve are of equal hardness, not only does the groove become apparent on the valve, but the bearing part of the seat tends to spread, and it will, I think, be admitted that (in reason) the broader the surface of the seat the more difficult the valve becomes to keep tight.

My suggested remedy is to make the

SUBSTITUTE FOR A WING.

valve a trifle softer than the seat, and if this point were looked to, less would, I think, be heard of patent seatings for valves.

A further difficulty arises in miter valves with three or more feathers, which are found invariably slack to the bore after but little service. As a remedy for this, I propose the valve with a circular sleeve, as in the sketch. An equal area of passage can be obtained, while a larger bearing surface for wear is provided. This type of valve is peculiarly suitable for boiler-check valves, and I have used them with complete success. If a careful fit is made to begin with, the wear is very small over a long period of time.

In valves of the double-beat pattern, the difficulty of obtaining a tight valve is increased by the unequal expansion due to the valves and stem having a higher coefficient of expansion than the different material of the valve chest. This has led to numerous methods of obviating the trouble with by-pass valves seated by springs, etc. I have yet to learn of a valve in which the stem and valves are of the same material as the chest, with brass faces to form contact with the seats. This would seem to present no insuperable difficulty in design. A. L. Haas.

London, England.

The Multiplication and Division of Logarithms.

At pages 226 and 366, several contributors briefly discuss methods of multiplying and dividing logarithms when the characteristic is negative. These are more or less meritorious, but in my opinion there is an easier and more satisfactory way than any given. Its chief point lies in the writing of the characteristic in the form $a-b$, the $-b$ coming after the mantissa, instead of in the form $\bar{a}$, the value of the logarithm, of course, remaining unchanged.

For instance, instead of putting down the logarithm of .3047 as $\bar{1}.483872$, it is written 9.483872—10. Similarly log. .03407 = 8.483872—10; log. .003407 = 7.483872—10, etc.

Following is the solution of a few problems. It will be seen that in division the key to the method is the adding of such equal positive and negative numbers to the compound characteristic that, after dividing, the resulting characteristic will contain —10. This establishes a sort of decimal system and a consequent facility of manipulation. In the solutions given, several processes are noted which, in reality, would be performed mentally.

Required, the logarithms of

I $.3047^3$

II $\sqrt[3]{.03407}$

III $.003047^{.3}$

IV $\dfrac{1}{.0003047^{.2}}$

Solutions:

I 9.483872—10
3
28.451616—30 = 8.451616—10

II 8.483872—10
20. —20
3)28 483872—30
9.491624—10

III 7.483872—10
.3
2.2451616—3 = 9 245162—10

IV 6.483872—10
.3
1.9451616—3

Log. 1 = 10. —10
1.915162— 3
8.054838— 7= 1.054838

Chas. G. Richardson.

Analysis of Some Engine-Lathe Drives.

I have been looking over the original article of Art Isan's on "Analysis of Some Engine-Lathe Drives," my comments on it, and his later article at page 433 replying to mine, but I fail to see where he finds anything to get into the "heat of argument" over. We have both called attention to a discrepancy between the Lewis formula for gear teeth and the established practice of an intelligent body of machine-tool designers. He, evidently a practical man, champions the formula; I, writing from a technical school, stand for the designer. It seems to me that Art Isan must misunderstand my argument, and if he does, others must too, so I will try to state my case more clearly.

First. I contend that lathe back gears give out from the shock of sudden stoppage of the work rather than from the legitimate stress due to direct belt pull.

Second. I contend that the allowance of only 8,000 pounds per square inch for gray iron allows a greater factor of safety than is necessary, considering that the general run of machine-tool castings are above the average quality.

Now for the first: If a lathe will stand the sudden stress of having everything brought up standing by the tool catching or the dog hitting the carriage or a reamer sticking, it will surely stand any stress that can be put on it through the medium of the belt. Since it is the exception rather than the rule that gears break when caught thus, it seems as if no greater argument were needed, and it certainly does not make any difference whether I ever saw a certain piece of work in a certain size lathe. For that matter, since Art Isan is a trifle personal, I wish to say that I have worn overalls longer than I have taught school, and that I incidentally built some 800 of the lathes referred to and had to take all the kicking from as many more that were built before I took hold, and that the experience referred to was true for these lathes and a few more that I have come in contact with.

I am not writing about what is done at the shops of the Worcester Polytechnic Institute, because they have several practical men better able to speak for themselves than I am for them.

Incidentally I put on the market over ten years ago a 12-inch lathe with practically the same design of cone pulley and gears and gear ratio that he shows as his choice (Fig. 10, page 767, Part 1) for a 14-inch lathe, except that the face gear and quill pinion were 1¾-inch face and 8 pitch instead of 3-inch face and 7 pitch. Nevertheless, I never heard of a quill pinion being broken, but did have to furnish a few new cone pinions.

I was ready to guarantee this lathe, properly speeded to rough out work 6 inches in diameter, and we furnished several with a gap to swing work 24 inches in diameter, and they would take a respectable cut on that diameter.

For the second point: The factor of safety, or, as it has been called, "the factor of ignorance," is put into the Lewis formula by allowing for the strength of gray iron only 8,000 pounds. We know that a piece of gray iron may be cast of such a mixture and of such a shape that it will break of itself from internal stresses. On the other hand, we know that it is possible to make castings whose strength is as high as 40,000 pounds or more. Lathe-gear castings are particularly well adapted to be free from internal stresses. Machine-tool foundries have to run a better mixture of iron than the average. Then it is not surprising if they turn out castings on which we may increase the 8,000 pounds item of the Lewis formula to 20,000 pounds, when we consider that a breakage of a part is not a vital matter. The fact that machine-tool designers do this, and, as Art Isan says, the designers are as bad from one part of the country as another, ought to bear some weight. Tool builders' customers are no more bashful than other men about demanding good goods. If there were anything very far off about the general run of lathe designs, they would hear from it with a will.

If the work strikes the lathe carriage or the tool catches and the lathe is brought to an instant standstill, it is the cone pinion that takes the punishment, for it has to take the fly-wheel effect of the cone pulley running fast and the part of the momentum of the countershaft that the belt can transmit. Most of this shock is absorbed by the quill gear before it reaches the quill pinion, so that its full force is felt only by the cone-pinion teeth.

Of course, if a designer figures on running so close to the expected breaking strength of his material, he must expect to have occasional gears that are not up to the standard and that will break when subjected to shock. Such is actually the case. I will not say that no quill pinions break, but that, judging by my own experience covering ten years or more,

more cone pinions break than of the other three together. Individual instances prove nothing general. Since these gears break almost always through accident, and since the user almost always pays for new ones cheerfully, it is hard to convince tool builders that there is any advantage in making a change. Nevertheless, I do advocate making the gears stronger, not one pair or the other alone, but all of them, keeping the cone pinion most liable to break, since it is the most easily replaced.

I do not see why the fact that I increased the strength of lathe-apron gears is any argument against what I have already said. It took ten years to do it, and it was a part of the evolution of lathe design.

Just one other comment. Strange as it may seem, there are practical men connected with technical schools—not a great many, but a few. And stranger still, they find a better reception from scientific and technical men than they do from their own former chums whose ranks they have left. There seems to be a feeling among shopmen that the man who has any connection with a technical school is lost beyond hope, and yet I can find within a stone's throw of my desk several men who could get into the shops and hold their own if they chose to conceal their identity.

E. H. FISH.

Multiplying by .7854.

The interesting number of factors into which the commonly used value of Pi can be split, giver by Mr. Cox at page 297, may derive additional interest from the short method of multiplication given below. It sometimes occurs that tables are not available when needed, and if we can reduce the labor of such a mechanical operation as multiplication, we minimize the chances of error.

When finding the area of a circle in the usual way four multiplications are required, one for each digit. The following method requires only one.

Example: To find the area of a circle of 3.7 inches diameter.

$$3.7 \times 3.7 = 13.69$$

13.69
.7854
9583
9583
19166
19166

Area = 10.752126

Multiply top line by seven, repeat one place to the right, double the above, repeat as before.

Proof of the foregoing:

7
7
14
14
7854

If the proof only is memorized, the method is fixed in the brain forever.

London, England. A. L. HAAS.

Two Methods of Machining Crossheads.

The article on this subject by "Corliss" at page 435 is quite interesting, but he fails to describe the most important part of the operation—that is, the boring out of the connecting-rod hole.

I would like very much to inquire how this particular operation was performed after the other operations were completed, as we all know both holes must be at right angles.

I. N. QUIRE.

Foreign Markets for American Machinery.

Any American firm of machinists supplying patented machinery to Japan should take an early opportunity of protecting their rights in that country, if they have not already done so, by fully patenting their machines. There is every reason to think that many inventions of American and British origin, although protected in those two countries, have not been patented in Japan. For instance, during the five years ended 1904 there were 138,109 patents granted in Britain, while the patents issued in Japan to Britons for the same period numbered only 269. The corresponding numbers for American inventions were 138,661 and 682, respectively. We must remember that the United States, with England, are the two countries principally concerned with Japan, from a trade point of view, and that there are not wanting instances of imitations of American and British goods not patented in Japan. With the conclusion of peace, we shall probably see great industrial activity throughout Japan, and it is probable that "slim" Japs may not be averse to appropriating anything good that comes in their way. Unless inventors patent their inventions in Japan as soon as possible, they may find it too late to secure their privileges when they are awakened to the actual necessity of having their inventions patented in Japan, because by that time the official patent gazette of the foreign country, containing the description of an original invention, will have been placed in the library of the Japanese Patent Bureau for public inspection, and the inventions referred to will be unpatentable in Japan according to their laws. Your inventors and manufacturers should see that their inventions are patented in Japan *prior* to the publicity given to their inventions in Japan itself through the medium of the official patent office gazettes of their own country.

By the way, it is probable that Japan will soon be wanting a number of marine oil engines of from 2 to 50 horse-power to work her fishing boats, of which there are about 400,000 in all. The Marine Products Bureau of the Department of Agriculture has the matter in hand, and it has been asked to recommend a suitable type of marine oil engine of 20 horse-power for fitting in a fishing boat. The type of the boat for which this sort of engine is wanted is 60 feet long, 12 feet 6 inches in breadth and 6 feet in depth. The bureau will make a thorough study of the oil engines made in Great Britain and in the United States before coming to a decision. It would be as well for American makers to forward fully illustrated catalogues and prices to the bureau. While on the subject of catalogues, I may add that it is very essential that full information should be given to Japanese buyers in the way of prices, discounts, etc., as they cannot be expected to wait two or three months to obtain the information from the home manufacturers. There is business to be done in Japan by American makers of sugar machinery if they will make a closer study of the market. It should be remembered that the cane produced in Formosa is very hard; also that the machinery for dealing with it must be as simple as possible, and be capable of manipulation by relatively inexperienced labor. Up to the present, most of the sugar machinery in Formosa has been supplied either from England or Germany. There is no particular reason why American makers should not have their share of the forthcoming business, but they must supply the right sort of plant.

The native press in Japan report the proposed establishment of a paper mill at Nakatsugawa (Gifu prefecture) on an extensive scale, and that several leading Tokyo capitalists are interested. Makers of paper-making machinery should make a note of this, because there will be some good orders to be had a little later on.

The Government of Bolivia intend to develop their country by the construction of railroads. I would suggest that American manufacturers of the required plant send their catalogues to the United States consul at La Paz; but the catalogues must be in the Spanish language, and must indicate weights, measures, prices, discounts and every possible detail, as is done by competing countries. Another very important step that should be taken by manufacturers of mining-plant machinery and tools of every description is that of the establishment of depots or agencies at Oruro, the most important mining center, and at Antofagasta, the port for that center. German firms have representatives at the above-named places, and they supply the most immediate needs of the mines, thus securing a good deal of the trade. It is very desirable that all machinery should be made in sections to facilitate its transport by mule-back. The weight of any package should not exceed 350 pounds. There is no duty on machinery of any description imported into Bolivia. This is rather an important fact,

because, during the present boom in tin mining, all kinds of labor-saving machinery and appliances have been introduced to render the work as nearly automatic as possible; but there is plenty of room for more plant in the same direction. During the past year two anthracite gas engines have been imported into Oruro from Germany, to take the place of steam engines, because fuel is so scarce. Coal costs over $40 a ton, and the mining district is upward of fifty miles from the railroad. Germany competes with your manufacturers in supplying a good many of the mining tools, such as hammers, shovels and picks; and the same sources supply the hand-cars and steel rails. At present there are at Oruro no direct importers of these articles. Steel rails from Chile cost, delivered at Oruro, over $2 per meter; whereas the same article, obtained direct from Germany by German merchants, is sold at $1.60. Spare shoes and dies for stamp batteries are supplied by British houses. There are openings for farm implements and tools, butter and ice-making machines, mining and general tools, portable printing presses, and all sorts of labor-saving devices. I may add that American makers of railroad plant ought to have a good chance of competing for orders for such manufactures, inasmuch as the commission entrusted with the survey of the railroad routes is entirely American, and they will naturally lean toward their own manufactures.

F. C. C.

London.

Export of Manufactures.

The record of the foreign commerce of the United States during August strongly reflects the prosperous condition of trade and industry. Figures just published by the Department of Commerce and Labor, through its Bureau of Statistics, show that exports of manufactures during the single month of August have increased nearly $9,000,000, or about 25 per cent., as compared with the same month of last year, and about $20,000,000 as compared with August, 1901. Meantime, the manufacturers have increased their consumption of materials imported for use in the various processes of domestic industry, the August, 1905, imports of crude articles for use in manufacturing having increased nearly $2,000,000 over the imports of August, 1904, while there is an increase of about $50,000,000 when the eight months ending with August of this year are compared with the corresponding period a year earlier. That class of manufacturers' materials designated as "wholly or partially manufactured" also shows increased imports—about $1,000,000 during August and over $13,000,000 during the eight months ending with August.

During the eight months ending with August, 1905, imports of manufactures, including all degrees of manufacture, aggregated $322,000,000, while exports of manufactures amounted during the same period to $376,000,000.—*Consular Trade Reports.*

Technical Education for Cincinnati.*

BY HERMAN SCHNEIDER.

In order to ascertain just what requirements an engineer should fulfil, it is necessary to see precisely what relation he holds to industrial activity. Now industrial activity is chiefly concerned with supplying the necessities of life. Railroad systems, steamship lines, stock exchanges, industrial corporations—all are parts of an economic system to feed, clothe and house us. In fact, nearly every form of business life is either directly or indirectly a means to the end of supplying human needs. What, then, is the engineer's position in this economic scheme of supply?

Consider a grain of wheat from the time it is planted until its yield is used for its destined purpose. The farmer plants it with a machine; the cost of the machine is therefore a charge against the product. The machine is made of steel and wood. The ore for the steel is mined probably in the Superior region. The cost of mining it depends largely on the skill of the civil, electrical, mechanical and mining engineers who plan the operations, design the drilling and transporting machinery, and construct the transferring appliances. The cost of taking the ore by rail from the mine to the lake carriers depends largely on the cost of the locomotives, the cars, the rails, the bridges, the track construction, the maintenance, and, further back, the economic location and the first cost of the railroad. When the ore reaches the lake it is transferred to boats. The skill of the engineer who designs the transferring and conveying apparatus fixes a part of the cost of this operation. The vessel which carries the ore down the lakes is an engineering product, and the freight charge is a direct function of the cost of the ship, which is, in turn, a direct function of the abilities of the engineers who constructed it. The ore is transferred later to another railroad, thence to the furnaces to be made into pig iron, to the open-hearth or bessemer furnace to be made into steel, to the mills to be shaped, to the factory to be assembled into a machine, and finally to the railroad for shipment to the farmer; and the costs in all these stages are dependent on the bridge builders, the locomotive builders, the car builders, the rail manufacturers, the conveyor makers, the mill designers, the assayers, the engineers. Therefore the cost of the machine, which is a charge against the wheat, is directly dependent on the abilities of our engineers.

When the harvest is ready, another machine is used. Still another is used for threshing. As before, these are engineering products. The grain is stored in an elevator, which is also an engineering product. It is transported by rail to the flour mill, and this is an engineer's problem. The flour mill is the result of engineering skill from the cotton-waste and oil to the most intricate bit of mechanism. And finally, the flour, the finished product, is put into bags or barrels (made by machinery) and transported by railroads and steamships to its destination.

Similarly, if the paths of the things we wear and of the articles we use in our houses be followed from the raw material to the finished product, it will be found that the engineer enters appreciably into their costs.

This close and important relation of the engineer to industrial activity is further strikingly shown by the fact that nearly the whole output of the United States Steel Corporation is made under the direction of engineers, and is used by engineers in their services to their fellowmen.

The influence of the engineer on cost is also shown by the great reduction in freight rates during the last twenty years, during which time the cost of labor has increased.

Moreover, commercial life is concerned not only in holding and supplying the home market. There is a constant struggle between the nations to obtain commercial supremacy abroad. Perhaps our keenest competitor in the marts of the world is Germany, and this competition is primarily a contest between the technical men of the two countries.

Therefore, since our engineers occupy such an important place in commercial life, it seems but natural that we should examine carefully the qualifications which they should possess in order that their preparation may be properly accomplished.

The engineer's function in the social fabric is to handle efficiently and economically the various materials he uses in his services to mankind. These materials are subject to certain natural laws, many of which have been definitely formulated. The clear comprehension of these fundamental principles of science is therefore necessary to an intelligent use of the materials whose actions they constantly govern, and in connection therewith must be taught the practical application of these laws to the materials as used in construction. This is the engineer's foundation. Many instances could be cited where intelligent applications of scientific principles have resulted in a great reduction in the cost of commercial products. It is further necessary for an engineer to conform to certain man-made laws, customs and methods, without a thorough understanding of which he cannot work economically. For it is a fact known to all practicing engineers that a knowledge of the laws of contracts and specifications is almost as

*An address before the Cincinnati Society of Mechanical Engineers.

necessary to the successful completion of the project as a knowledge of the laws governing the materials contracted for and specified. And further, since a great part of the engineer's working day is occupied by business processes, which are vitally involved at every stage of his work, he must be familiar with these business forms and customs.

Moreover, since the engineer is so vital to the broad economic scheme of life and it to him, he should have that extended view of economic relations which can be had only by a thorough study of what is generally termed Political Economy. That is to say, he should be taught not only what business is in the concrete, but what it is in the abstract; not only to handle successfully the intimate business details of his own profession, but also to understand the relation of his profession to other fields of labor. Any combination of conditions which would bring the business elements of a problem into intimate relations with its technical solution, would therefore seem to be a desirable advance in technical education. It would tend to a more uniform symmetrical and natural development. It is further necessary for the engineer to be able to deal with men, that is with the men one employs and by whom one is employed. Sooner or later the young engineer is brought face to face with the labor problem, which will prove to have a very important bearing on his progress. He will also have to enter into contract relations for his employer or for himself, and in all these details his ability to deal with men will mean much to him.

The foregoing considerations lead to the conclusion that the engineer should possess the following qualifications:

He should be firmly grounded in the fundamental principles of science.

He should be able to apply these principles in practice.

He should be specialized as far as possible.

He should possess a knowledge of achievements in other fields of engineering.

He should be well equipped to deal with a situation involving a knowledge of fundamental business forms and processes.

He should know men as well as matter.

He should have a fair degree of culture.

He should be well drilled to do his best naturally and as a matter of course; to obey implicitly, to command intelligently and with toleration, to be accurate and systematic, to write clearly and concisely.

Now it is a fact of observation that it requires certain peculiar gifts of nature to make a highly successful lawyer, doctor or theologian. So also does it require certain tendencies and aptitudes for a successful practice of engineering; as the phrase of the day has it, certain men are "cut out" to be engineers. An effort should be made to obtain these men.

The speaker does not believe that the process of elimination by examinations during the college course leaves a residue of the best material obtainable. He advocates the adoption of a system which will secure as nearly as possible such young men as will, when properly prepared, possess the necessary qualifications of highly skilled engineers. Any plan therefore, looking to improved conditions must select young men, mentally and physically sound, temperamentally adapted to engineering and serious in their purpose. It should further give opportunities to men who possess these qualifications, but whose financial condition is such as to make the college course an impossibility to them.

The solution of this problem in Cincinnati seems to lie in a co-operation between the various industries in the city and the engineering college of the university, upon the following lines: The owners of the industries will select from their works such young men as in their opinion have within them a degree of engineering ability. These young men would work one-half day at their factories and spend the other half at the university. Special courses, covering a period of five years, would be arranged for these men, at the end of which time they would receive the technical degree of their course, just as our regular students do after four years of regular attendance. Much of the regular university work would be omitted for these special men, where they could get the equivalent of that work, such as drawing, engineering laboratory work, etc., at their manufacturing plants. It would be necessary of course for these young men to have had a high-school education.

It will be seen that we aim to have the young men at the university three hours every morning studying technical and cultural subjects, who will work every afternoon at various plants in the city. Now, it is admitted that it will entail a certain financial sacrifice and administrative inconvenience on the part of the co-operating companies to have even a small number of men working half time with them. The advantages derived by the companies must be placed, however, over against this one disadvantage. The students are really apprentices in the works. The works will, in fact, be training their own engineers. They will have bright young men, selected by themselves, highly trained in theory, versed in the practical side of their profession, acquainted with the forms of business methods by constant contact with them, supplemented by the broader outlook which the university will give by course in business law and political economy. These young men would further possess knowledge of the labor problem by intimate acquaintance with the conditions existing in actual practice.

And finally, a combination of these conditions will teach the student to do his best, naturally as a matter of course. It will start him on his lifework with a symmetrical and uniform fundamental development of his engineering, his business and his social parts; a development of which will continue evenly and make of him a skilled engineer, a safe business man and a broadly tolerant and intelligent citizen.

The university will probably go further and establish a night course of higher technical theory for the more advanced men of our industries, such as superintendents, draftsmen and foremen, who are required at the plants throughout the day, but who feel the necessity for further theoretical knowledge. This work would not, of course, lead to a technical degree, but would be special work and more restricted but theoretically just as high as regular college work. Upon these men depends largely the industrial welfare of the city. The problem of sound engineering education is, therefore, one which commends itself to the serious attention of business men as well as to teachers of engineering.

The university is eager to do its share in preparing civil engineers, mechanical engineers, electrical engineers and chemical engineers of a high grade, such as these men would undoubtedly be, to help carry to still greater success the industrial life of Cincinnati. In this it hopes to have the hearty co-operation of the business interests of the city.

The Canadian Pacific Railway is arranging to provide quarters in close proximity to the new Angus shops, where the 5,000 or 6,000 workmen employed may be able to get a good square meal in the middle of the day at a reasonable figure. Mealing accommodation being so poor in the neighborhood of Rosemount, and no one appearing to be anxious to open dining-rooms and charge rates which the railway officials thought satisfactory, the company decided to take the matter into its own hands and provide all the facilities necessary. The majority of the men are unable to get home for their mid-day meal, living three or four miles away from the works, so it is expected that the dining-rooms will be well patronized. There will be two rooms, each about 140 feet in length by 35 feet in width. They will be equipped with all the necessary cooking utensils, tables, chairs, etc., and will be built of red brick similar to the kind used in the construction of the shops. Work has already been started on the foundations, and it is expected that they will be completed and in operation before the winter sets in. Similar rooms were opened by the American Locomotive Company at Schenectady a few years ago, and have proved to be very popular.—*Railway and Engineering Review.*

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Technical Education for Shop Men.

We publish in another column a recent address before the Cincinnati Society of Mechanical Engineers by Professor Schneider, of the University of Cincinnati, which deserves more than a passing notice.

It will be observed that the author contemplates co-operation between the manufacturers and the University of Cincinnati and the organization of a special course which shall recognize the work done at the shops as part of the course, which is to be a full engineering course with the recognition of a degree at its end, thus placing these students on a par, in this respect, with others.

The plan outlined is in line with the sympathies of this paper, but it seems to us that an entirely feasible modification of it is necessary for its complete success, and even for any large success. The author contemplates the presence of these students at the University in the morning and at the shops in the afternoon—a plan that would seriously embarrass the manufacturers and put serious limitations on the shop work which could be given to the students. No manufacturer can afford to have several expensive machines lie idle during the morning, in order to be ready for the student apprentices in the afternoon; nor would it be feasible for him to arrange the work in such manner that other workmen would operate the machines in the morning and be turned over to the students in the afternoon, as it would be about as serious a matter to provide work for the first workman during the afternoon as to have the machine stand idle during the morning. The plan necessitates an under-manned shop during the morning or an over-manned one during the afternoon; in the former case involving idle machines and lessened output, and in the latter more men than could be profitably employed.

To meet these difficulties but two changes of plan are necessary: Let the University classes be held in duplicate morning and afternoon, and let each shop provide students in pairs—student A working in the shop and student B doing his University work in the morning, and the two changing places during the afternoon. The shops would then be manned to the same extent morning and afternoon, the only remaining shop difficulty being that due to the transfer of work from one student to another. Of course the University would be saddled with the difficulty due to an increase in the number of classes conducted, which would naturally involve an increase in the teaching force. This difficulty resolves itself, of course, into the provision of the necessary funds to pay the salaries of more teachers.

As thus modified, the plan becomes closely analogous to the half-time school which has been so ably advocated by Professor Higgins, and we believe it has all the possibilities of that scheme. As thus modified, we believe the plan to be feasible and to contain large possibilities for good. Since the students would earn money by their shop-work, it would go far toward providing engineering education for those who are now barred from it by the simple lack of funds. There is no greater educational problem before the country than this, and it goes without saying that the students thus selected would possess those natural aptitudes which are necessary to the successful engineer. We have no doubt whatever that they would, as students and as engineers, distance the high-school boys who now monopolize engineering schools. We have no doubt whatever that the plan would meet with immediate and large success, and be soon adopted in other schools which are so situated as to make it possible. Consider, for example, the opportunity which it would offer to the Worcester Polytechnic Institute; to the University of Pennsylvania and to the Case School of Applied Science. It would be vastly to the credit of the University of Cincinnati to be the institution to inaugurate it.

One of the most encouraging notes in Professor Schneider's address is the recognition that "the process of elimination by examinations during the college course does not leave a residue of the best material obtainable." This should be obvious to everybody, and one of the points urged by Professor Higgins is that the half-time school would provide a far better test of fitness.

By all means let the plan be tried. Large success awaits it.

American Shortcomings in Seeking Foreign Trade.

Our English friends, after having been berated for years by their own observers for their failure to act intelligently when endeavoring to sell goods abroad—American methods having been repeatedly held up as models for them to follow—are finding a good deal of comfort in some criticisms of American methods by American consuls, in which American exporters are accused of doing pretty much all the stupid things which were supposed to be confined to British houses.

The Engineer for September 22 publishes, with very pardonable satisfaction, some extracts from a recent report by Consul Skinner, of Marseilles, who states that American manufacturers, with few exceptions, lay down conditions utterly discouraging to the foreign inquirer, and adds that "the general attitude of American manufacturers and their army of general sales agents, brokers, foreign commission buyers, with their cash-over-the-counter, and you-pay-the-freight terms, savors still very much of the circumlocution office, and how not to do it." All this is so like what our contemporary is accustomed to see from British consuls, that it is led to inquire if it is not a case of possible collusion!

Equally comforting things are found in the report of a special American agent in Japan, who reports that "instances have been repeatedly cited where our goods have been discarded by the Japanese after original orders have been given or after business has been in progress for some time, because American shippers persisted in sending in goods below the standard of the sample submitted. Everything is done by the English and Germans to retain their present foothold and to increase and broaden the market." He states also that Japanese suggestions as to changes in design are at once acted upon by the English houses, while Americans seem to adopt the rule which we have been taught was peculiarly that of John Bull—"That's my sort; if you don't like it, leave it!"

American methods of packing also come in for condemnation. On this point, however, our contemporary would derive added satisfaction from a paper read at the recent convention of the New England Cotton Manufacturers' Association by S. S. Dale, editor of the *Textile World-Record*. Among other things Mr. Dale illustrated by half-tones from photographs the condition in which American raw cotton reaches the docks of Liverpool, and which we know of no word to describe—disgraceful is hopelessly inadequate. Nothing worse could be imagined, and nothing so bad would be believed in advance by anyone.

The tendency of modern education toward the practical side is shown by the fact that the registration at the Sheffield Scientific School of Yale is this year larger than that of the Academic department for the first time in the history of the University. There are this year 410 registrations in the Sheffield Scientific School, and 396 in the Academic department.

New Tools and Machine Shop Appliances.

ENGINE LATHE FOR LARGE OUTPUT.

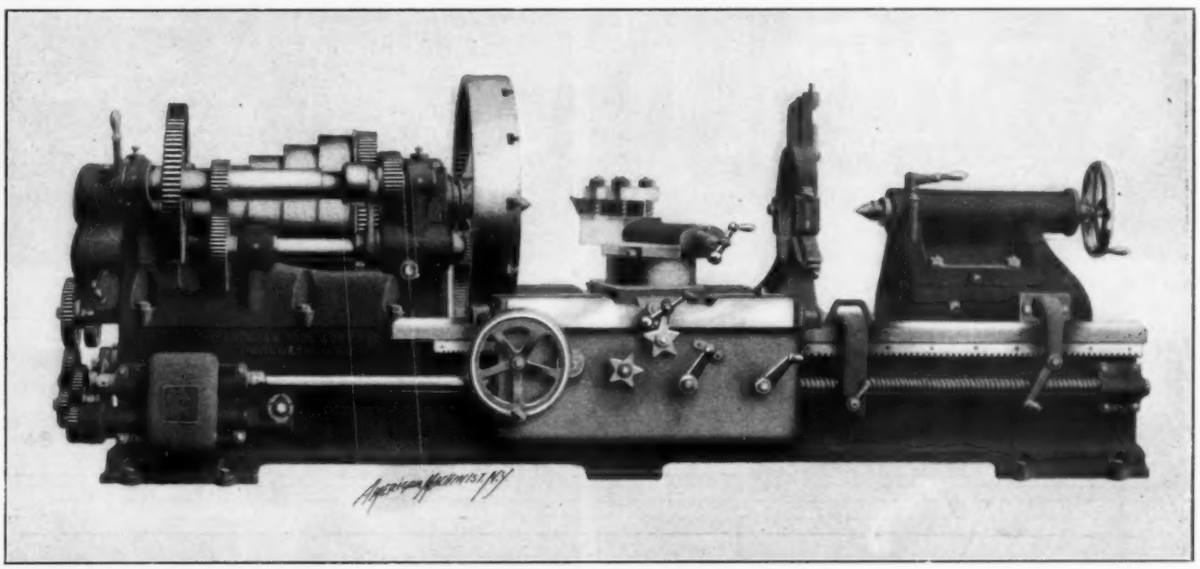
The illustration shows a heavy lathe made in 36- and 42-inch sizes, and provided with a new style quick-change gear mechanism. The standard length of bed is 12 feet, which length takes 4 feet 9 inches between centers. The 36-inch lathe swings 38 inches over the V's, and 26 inches over the carriage; the 42-inch size swings 43 inches over the wings of the carriage, and 33¼ inches over the bridge of the carriage.

The quick-change gear mechanism provides thirty-two changes for feeding and thread cutting, the range of threads being from 1 thread in 4 inches to 16 threads per inch, including 11½ pipe thread. The feeding range is 6.4 to 92 cuts per inch. The device can be operated while running if desired, the adjustment being accomplished by revolving nut at the right of the gear box beneath the head, which moves a sliding key, engaging two opposed gears, each being one of a cone of gears contained in the gear box. The feed or screw pitches thus obtained are multiplied through the compound gears on the quadrant at the end of the head, it being necessary to change one gear only on the quadrant for each additional thread. This arrangement gives flexibility to the screw-cutting mechanism, making it possible, through the introduction of certain gears, to cut practically an unlimited range of special worms or threads, either finer or coarser than the range indicated above.

The bed is of the drop-V pattern, which gives 2 inches additional swing; it is provided with cross box girders at intervals for its entire length. The bed is further strengthened by a rack cast in the center, for engaging the pawl of the tailstock. The largest of the five cone steps is 20 inches in diameter, the face being 4¾ inches. The headstock spindle has a 2⅞-inch hole its entire length. The triple gears are readily engaged by rack and pinion at the front of the head. The internal gear is planed integral with the face-plate, and the pinion is cut solid with the shaft. Fifteen speeds, in geometrical progression, are obtained.

In addition to the clamping bolts, the tailstock is secured against movement by a pawl engaging a rack cast in the center of the bed. The carriage has a continuous bearing of 50 inches on the ways. The apron is double, giving all shafts a double bearing. The longitudinal and cross feeds are both reversed from the front of the apron, this being a great advantage on a long lathe especially, saving the operator from having to go to the head.

The top slide of the compound rest is provided with power angular cross feed.



ENGINE LATHE FOR LARGE OUTPUT.

with 13½-inch travel. The miter gears are steel, planed from the solid. The swivel is graduated, and the top slide and cross-feed screws have micrometer dials. This machine is built by the American Tool Works Company.

New Publications.

"Architectural Drawing Plates." By Frank E. Mathewson. The Taylor-Holden Company, Springfield, Mass.

This is a collection of ten plates, showing approved constructions of frame building details.

"The Compression and Transmission of Illuminating Gas." By E. A. Rix. 46 6x9-inch pages, with numerous tables. The Journal of Electricity Publishing Company, San Francisco.

This pamphlet is a report of a paper read by the author at the July, 1905, meeting of the Pacific Coast Gas Association.

It includes the results of a thorough and painstaking study of the problems involved in transmitting illuminating gas under pressure, in which the author is an acknowledged expert.

"An Elementary Course in Mechanical Drawing." By W. D. Browning and F. A. Sibley. Part I: 58 6x9-inch pages, with 13 plates and 45 text cuts. Part II: 30 6x9-inch pages, with 10 plates and 20 text cuts. The Browning Press, Cleveland, Ohio. Price per part, 50 cents.

This course in mechanical drawing includes geometrical problems, orthographic projection, sections, intersections, development of surfaces, helices, screw threads, nuts and bolt heads.

It is reported from St. Petersburg that American capitalists have leased a number of Russian shipbuilding wharves on the Baltic and the Black seas, and that at these wharves new war vessels will be built, under the direction chiefly of American engineers and the work being done mainly by American workmen.

Molding (in One Piece) a 15-Foot Fly-Wheel in Dry Sand Cores.

BY S. B. RYDER.

In making a mold for a fly-wheel casting over 6 feet in diameter, perhaps the quickest way is to make the hub and arms in dry sand and the rest in green sand. In the case illustrated herein, the wheel is not one of the largest, being 15 feet in diameter and with a 29-inch face, but the job has some features worthy of mention.

The wheel was to be split into halves after being machined on the ends of the hub, bored to suit the shaft, and the rim and flanges or projecting lips on the side turned. At the lugs for bolting the halves together the splitting plates were to leave enough metal to prevent the shrinkage strains from causing the wheel to crack in two. The hub was entirely split in two and each side provided with four bosses for the bolts which clamped the wheel on its shaft, in addition to which it was supplied with keyways.

MOLDING.

There being no cope flask at hand sufficiently large, the means shown in the photographs were resorted to. It will be seen that very few weights were used, simply a row of pig iron against the rim and two weights on the hub.

In Fig. 1, box No. 1 is the arm box, one arbor marked *A* standing on end beside it and another marked *A* lying down with wickers on; these two arbors were used in the half-boxes of the eight arm cores, sixteen half-cores being required altogether. The formation of the bosses on the hub for the clamping bolts required the changing of a few loose pieces. The arbors with wickers went in first.

Box No. 2 makes the cores for the inside of the rim between the arms, the piece across the center forming the continuous rib extending from arm to arm, which can be seen in Fig. 5; the arbor for this box is marked *B* in Fig. 1.

Box No. 3 closes down in the center over the hub core, as shown in Fig. 3, and permits the claying up of the joints after

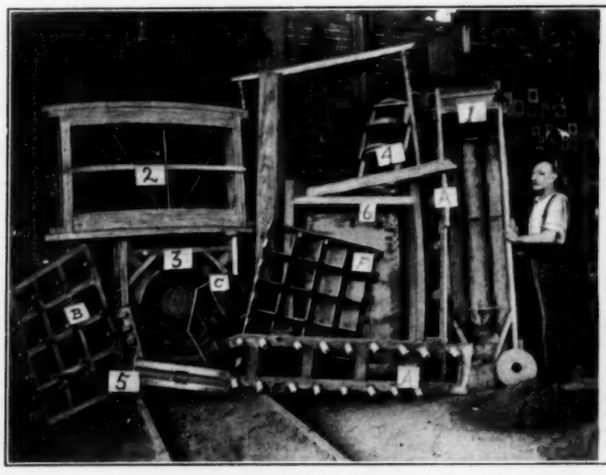


FIG. 1.

FIG. 2.

FIG. 3.

FIG. 4.

MOLDING (IN ONE PIECE) A 15-FOOT FLY-WHEEL IN DRY SAND CORES.

all the arm cores are set. Note the strips across the center of the box running into the core print; these are prints for guiding the splitting plates at the top. When it is considered that 19,000 pounds of metal had to be poured into this mold through its hub, the necessity for taking every precaution to secure these splitting plates is evident. The arbor marked *C* is for this box.

Skeleton box No. 4 is for the center core which is chambered.

Box No. 5 is the core-box for the holes in the hub for the clamping bolts, there being four 2½-inch bolts.

Box No. 6 is for the outside core, which is shown in position in Fig. 3. Its arbor *F* is supplied with a number of wickers which constituted the only clamp the rim had to prevent its straining in casting, and which worked to perfection.

The light frame showing in the picture inside of the rim, and all rammed up with black sand. In the foreground the form of the rib which runs between the arms is plainly visible; to the left of the photograph can be seen one of the two splitting plates in the rim; on the right a portion of the section of the rim with the projecting lip on one edge can be seen.

CASTING.

Fig. 4 shows the pouring of this wheel, there being only two weights on the gate box over the hub. The large ladle in the background contained 12,000 pounds of metal, and in the immediate foreground is a smaller ladle that contained 8,000 pounds; the latter is suspended from a small jib crane, the supporting of which required the scaffolding which makes a somewhat unsightly appearance in the photograph. At the instant Fig. 4 was taken the metal had filled the mold, and all the

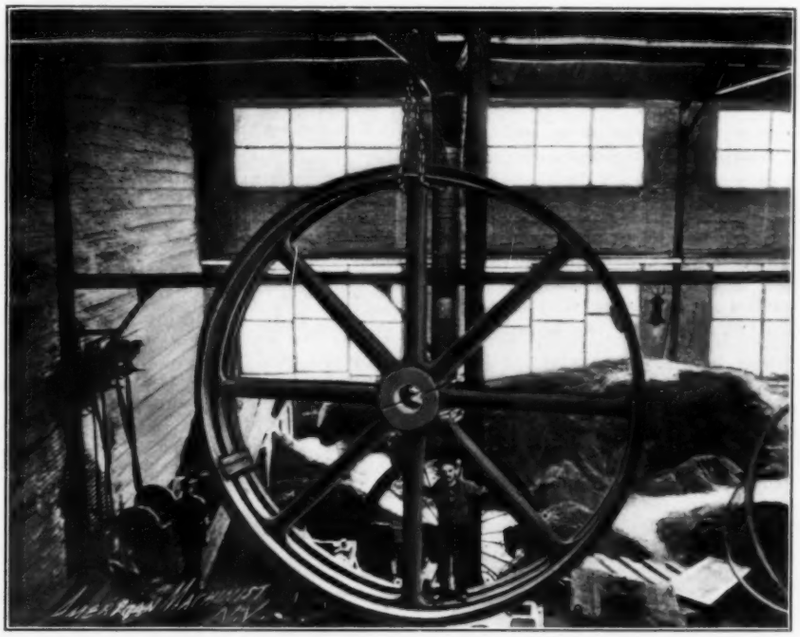


FIG. 5. MOLDING (IN ONE PIECE) A 15-FOOT FLY-WHEEL IN DRY SAND CORES.

over and around skeleton box No. 4 is used for turning over the cores from box No. 6 after being filled with black sand. In Fig. 2 the core-oven door is raised ready to permit the car to be run in to dry the cores made from box No. 6.

The round block with a hole in it slipped over the spindle and was used in setting the arm cores as shown in Fig. 2. Here can be seen four of the arms in their correct positions for placing splitting plate and the cores in the hub for the bolt holes.

Fig. 2 shows plainly how the arm cores were bolted together by clamps across the top and bottom. Previous to the setting of these cores a perfectly true bed was swept up and rammed sufficiently hard to permit of treading upon it in the work of placing the cores.

Fig. 3 shows all the arm cores in position, the cores between the arms on the vents were working nicely. The risers, one on each side, which are plainly shown, and their supplementary beds, made up like beds for pig iron, were filled in less than ten seconds after the operator of the camera had made this exposure, showing that the mold was full.

Fig. 5 shows the casting suspended from the electric crane after being weighed, with the boss molder standing between the arms. This wheel was for a 20x42-inch Corliss engine. Although not of unusual size, I consider its being cast in one piece and the method of making it worth more than passing notice.

The annual meeting of the American Society of Refrigerating Engineers will be held in New York city, on December 4 and 5, in the chambers of the American Society of Mechanical Engineers, No. 12 West Thirty-first street.

British Versus German Metal Workers.

Another instance of the investigating tendency which has lately been so much in evidence in England among persons connected with the manufacturing industries in regard to finding out what is done in their respective line of business in other countries, is furnished by a report made by a committee of gentlemen interested in the Birmingham brass industry. They went to Germany in order to compare the general status of the German workmen in regard to their training, efficiency, habits, etc., with that of the British workers and especially those in Birmingham. Their report is on the whole more or less unfavorable to the British workman as compared with his continental competitor. The investigation was mainly concerned with the condition of the brass workers in the city of Berlin, where there are 18,000 brass and zinc workers working at those trades out of a total of 50,000 brass and zinc workers in the whole of Germany. The workmen receive in wages from $7.50 to $10.50 a week, the hours of work being from 7 A. M. to 5 P. M., half an hour being taken for breakfast and dinner. Piece-work is stated to be common, and the ventilation of the shops, the carrying off of the noxious fumes, dust, etc., is being carried out to a considerable extent, owing to the very stringent requirements of the German government in that respect. The Government has within recent years been paying considerable attention to the safeguarding of the health and comfort of workmen in general, and the laws passed to that effect are rigidly enforced. The men therefore work generally under better conditions, and they possess more comfortable homes, etc., than their brothers of the craft in Birmingham. Some of the conclusions which the authors of the report come to are quite interesting. They state, for instance, that the finish of the work of Birmingham manufacturers, particularly their polished brass work, is most excellent and that designs and models are also excellent as long as they are confined to the reproduction of plain articles as characterized the national British styles in models, which may be produced without plastic treatment and without help from the trade artist in wax and plaster. If the manufacturers, however, want to compete in the German, French or Italian styles they find a dearth of artists to get up the designs and models. Such artists, however, are supplied in Berlin by the excellent training schools, and they find plenty of employment, their work being supplemented by the efforts of workmen who have been systematically trained in the requirements of the art of casting and finishing articles. The interesting conclusion is reached by the investigating committee, that it is on the intellectual side that Birmingham requires to adapt itself to changed conditions; not to cheap-

ening its wares, but to get more conception into them. The latter desideratum used to apply also to the United States, but happily now we seem to have entered a period, and be already pretty well advanced in it, in which the artistic taste of the general public is becoming developed and where even articles of common use are required by the buyers to have an artistic appearance and finish. There is no doubt that in these lines progress will be made rapidly, with characteristic American push; and that in the not far distant future there will be produced in this country artistic work in the casting and finishing of numberless objects, such as there is none better anywhere in the world.—*The Metal Industry.*

Purchase of a Worcester Machine Tool Company.

The Draper Machine Tool Company, of Worcester, Mass., has been purchased by the Whitcomb-Blaisdell Company, of the same place.

An Impostor.

We learn that an impostor is again going about among the machinery firms of this country, representing himself to be connected with one or another of prominent European firms doing business with machinery manufacturers here. In one place he represents himself as being a member of the firm of Fenwick Frères, of Paris. In each place he visits he manages to secure about $50 on one pretext or another, and is evidently a fraud, against whom our readers should be on guard.

This man is described as weighing about 160 pounds, has a clean-shaven face, sandy hair, and is about thirty-four years of age. He evidently takes pains to be well informed regarding the firm whom he claims to be connected with, and is able to prove himself familiar with many points of their business. Whether this description fits a given case or not, it would seem to us that our readers ought by this time to be rather careful in the case of a man who claims to be connected with a foreign machinery house, and who for any reason or upon any pretext wishes to obtain cash. Men who are really what they claim to be, and who may happen to be in need of currency, will usually have the means of proving their identity, and in view of the circumstances should take no offense at being asked to do so.

The much-discussed merger of Harvard University and the Massachusetts Institute of Technology has been shown to be impossible under present conditions, and it has, we understand, been finally given up, and the two institutions will go their separate ways.

Personal.

Readers are invited to send information for this department.

Clayton R. Burt, who has been connected with the Brown & Sharpe Mfg. Co. for the past 13 years, has accepted a position as superintendent of the Barber-Colman Co., at Rockford, Ill., and will move there with his family.

Heinrich Dreyer, who was for a number of years with Schuchardt & Schütte, in Berlin, and in various other of their offices, has started a machinery selling establishment of his own in Berlin, at 47 Kaiser Wilhelmstrasse. He will handle American machine tools principally, and has the agency of the Bullard Machine Tool Co., Hendey-Norton Miller, Hartford Machine Screw Co. (for automatic screw machines), Mitts & Merrill (key seaters) and others. Mr. Dreyer has recently returned home after a month's visit to America.

Obituary.

William Dean, for many years chief locomotive superintendent of the Great Western Railway, died at Folkestone, England, September 17. He was a very able man—maintained a high standard of excellence in his department and directed the energies of as many as 13,000 men. He was a member of the Council of the Institution of Mechanical Engineers.

H. Winfield Wyman, of the firm of Wyman & Gordon, drop-forge manufacturers, of Worcester, Mass., died in Worcester, October 11, after an illness of three weeks with typhoid fever. Mr. Wyman was born in Worcester, May 30, 1861, was educated in the public schools there and graduated from the Worcester Polytechnic Institute in the class of 1882. In partnership with a classmate, the drop-forge business was started, which has grown to its present large proportions. Mr. Wyman was interested in other enterprises in Worcester, and was a member of a number of clubs there, in Boston, in New York and Cleveland. He leaves a wife and three children.

Business Items.

The Cooley General Development Company, Jamaica Plain, Boston, Mass., builder of the Cooley rotary engines, a manufacturing company, has entered into co-operative relations with a selling corporation entitled the Cooley General Development Selling Company, Boston, Mass., with offices at 620 Atlantic avenue, which company will have exclusive sale of the Cooley rotary engines in the future, and all communications should be addressed to the latter company from now on. The officers of the new corporation are J. F. Cooley, president; Josiah Quincy, former mayor of Boston, treasurer, and Lieut. Walter Bail, U. S. N., secretary.

Manufacturers.

The Williamston (Mich.) Knitting Company will put up a new factory.

The Baines Carriage Works, Buffalo, N. Y., will be moved to Hamilton, Ont.

The Plehler Shoe Company, Rochester, N. Y., will construct an $11,000 factory.

An addition will be built to the dye-works of D. Goff & Sons, Pawtucket, R. I.

The Pelton Water-Wheel Company, San Francisco, Cal., will build a new factory.

An addition is being built to the foundry of the Aird-Platt Company, Watervliet, N. Y.

The C. F. Hardy Food Company, Marshall, Mich., will erect a new plant, to cost $50,000.

The Sweet-Orr Company has let contract for a $10,000 addtion to its Joliet, Ill., plant.

A new $10,000 factory will be erected for the Skedden Brush Company, Hamilton, Ont.

A branch of the Gypsum Products Company, of Buffalo, N. Y., will be established in York, Pa.

Plans have been filed by the Liberty Brass Company, Buffalo, N. Y., for a $6,000 foundry.

The Winget Concrete Machine Company, Columbus, O., is erecting a new plant at Plain City.

The Michigan Steel Boat Company, Detroit, Mich., will enlarge the capacity of its plant.

The Wachusett Thread Company, Worcester, Mass., will erect a new mill, to cost $4,000.

H. H. Arnold, Rockland, Mass., will enlarge his machine shop and install new machinery.

The 1900 Washer Company, of Binghamton, N. Y., will erect a factory in Antwerp, Belgium.

The Sandusky (O.) Portland Cement Company will erect a $750,000 cement factory in Dixon, Ill.

A $55,000 building is being constructed for the Layton Pure Food Company at East St. Louis, Ill.

The Marion (O.) Steam Shovel Company will build an addition to its boiler and carpenter shops.

Crane Brothers, silk throwsters, Tobyhanna, Pa., will erect a branch factory at Kingston, Pa.

The plant of the American Can Company at Davenport, Iowa, was destroyed by fire; loss, $150,000.

Hitch Bros., Champaign, Ill., will rebuild their grain elevator, recently destroyed by fire at West Ridge.

Cornell Brothers, of Elgin, Ill., will erect a $10,000 bottle and milk-condensing plant at Maple Park, Ill.

Stacy Reeves & Sons, carpenters and builders, Philadelphia, Pa., will put up an addition to their factory.

The Jones & Laughlin Iron & Steel Company, Pittsburg, Pa., will make a big extension to its plant.

The Whitman Carriage Company, Brockton, Mass., has completed plans for a large addition to its plant.

The Post & Sheldon Corporation, of Paterson, N. J., will erect an addition to its silk mill at Slatington.

The S. Morgan Smith Company, York, Pa., will enlarge its plant, increasing the output of its water-wheels.

The J. B. Owens Pottery Company, Riverhead, N. Y., will build an extension for the manufacture of tile.

The Tewes Bros. Ice Company, of Chicago, Ill., has begun the erection of a new icehouse at Silver Lake, Wis.

The William Kavanaugh Company, Norwalk, O., is building a plant for the manufacture of oil-well tools.

The New Haven (Conn.) Gas Light Company will erect an addition to its plant, to be used as a purifier-house.

The Meriden (Conn.) Fire-Arms Company, it is said, is contemplating a new factory building, to cost $50,000.

The Hicks Gas Motor Company, Waycross, Ga., recently incorporated with a capital of $250,000, will erect a plant.

The National Biscuit Company, Chicago, Ill., will award contract for the construction of a plant in Des Moines, Iowa.

The Link Belt Supply Company, Minneapolis, Minn., will soon begin the erection of a new three-story machine shop.

The plant of the New Home Sewing Machine Company, at Orange, N. J., will be increased by another new building.

The Buffalo (N. Y.) Steam Pump Company will put up several new building at its plant in North Tonawanda, N. Y.

The Stewart Brothers Company, Elmira, N. Y., will build a larger plant to manufacture its extracts, toilet waters, etc.

D. H. Burnham & Co., Chicago, Ill., are the architects for a proposed $200,000 central electric light plant in Chicago, Ill.

It is reported that the Great Northern Railroad will build shops and a roundhouse in Minneapolis, Minn., to cost $1,000,000.

The Western Cartridge Company, East Alton, Ill., is planning to erect a new factory for the manufacture of shotgun shells.

The O. M. Edwards Company, Syracuse, N. Y., will build a new factory to increase its output of trapdoors and window fixtures.

The Plant Manufacturing Company, a wood-molding concern of La Porte, Ind., may establish a branch factory in Cincinnati.

The Inter-Mountain Electric Company, Salt Lake City, Utah, is planning to establish an auxiliary steam power plant at Coalville.

The Watson Paint & Glass Company, McKeesport, Pa., will erect a new factory and an addition to its warehouse, to cost $30,000.

Jacob Baumberger, Eau Claire, Wis., has purchased a plant which he will remodel and install machinery for making butchers' boxes, etc.

The shoddy mill of Herbert Pease, at North Vassalboro, Me., was destroyed by fire, causing a loss of about $12,000. It may be rebuilt.

The Avery Manufacturing Company, of Peoria, Ill., contemplates the erection of a new plant at Fargo, N. D., to replace the present one there.

The Alabama-Louisiana Coal Company was incorporated at Russellville, Ala., with a capital of $200,000. W. S. Douglass, Russellville, will be superintendent.

The Frankfort (Ky.) Chair Company is establishing a branch factory, which will be devoted almost exclusively to the manufacture of double cane chairs.

The Couple-Gear Freight Wheel Company, recently organized at Grand Rapids, Mich., has let the contract for a factory. The office is now in the Pythian Temple.

The Kilbourne & Jacobs Manufacturing Company, Columbus, O., making wheelbarrows, trucks, etc., will make extensive improvements and enlargements to its plant.

The Diebel Manufacturing Company, of Long Prairie, Minn., will move to Thief River Falls, increasing its capacity for manufacturing bank fixtures, post-office fixtures, etc.

The Great Western Granite Company, Omaha, Neb., has been incorporated, and will at once erect a factory. Incorporators, Edward C. Freeman, J. A. Hamilton, etc.

The Brighton Boat & Supply Company, a new concern composed of Andrew Lind, L. H. Moore and John A. Olmstead, of Appleton, Wis., will erect a factory near Brighton Beach, Wis.

The Pre-payment Electric Meter Company, Ltd., will be incorporated at Peterboro, Ont., with a capital of $100,000. Albert Amos Hollingshead, a banker of that place, is interested.

The Strong & Northway Manufacturing Company, Minneapolis, Minn., engaged in the general machine business, but making a specialty of flour-mill machinery, will erect a $50,000 plant.

The Red C Oil Company, whose plant at Highlandtown, Md., was burned recently, has already started to rebuild, and the plant of Sherwood Brothers, burned at the same time, will also be rebuilt.

The Shupe-Williams Candy Company, Ogden, Utah, will erect a new factory, to be equipped with the most modern machinery, steam and electric lighting plants, as well as a refrigerating plant.

The Fore River Shipbuilding Company, Quincy, Mass., has completed a large addition to its pattern and joiner shop. This is being equipped with new tools and necessitates the employment of more men.

The Benedict Manufacturing Company, to manufacture gas and gasolene engines, has been formed, and will establish a plant in Salamanca, N. Y. Paul C. Benedict, of Salamanca, is one of the directors.

The Florence (Ala.) Machine & Railroad Supply Company has been organized for the purpose of manufacturing the Carden smooth-surface roller cattle guard. Maj. A. J. McGarry, of Florence, is president.

The Wood Worsted Mill Corporation was organized at Portland, Me. The capital stock of $1,000,000 is owned by the American Woolen Company, Lawrence, Mass., at which place the new plant will be erected.

The Livingston Manufacturing Company, Rockland, Me., has awarded contract for a new building, to be used as a machine shop and forge-room, for the manufacture of granite workers' and contractors' tools.

The Specialty Manufacturing Company, with a capital of $10,000,000, has been organized in Lafayette, Ind. The company will manufacture an automatic railroad switch and other devices. Wm. P. Jester is president.

The New York Steel Company, with a capital of $1,000,000, has been incorporated at Buffalo, N. Y., where a large plant will be erected. W. G. Case, S. R. Mann, W. M. Evarts, of Buffalo, and others are directors.

The city of Petersburg, Va., purposes heating the court-house and some other buildings by low-pressure steam, and is inviting bids. C. M. Walsh, chairman of the Public Property Committee, has plans and specifications.

The German Clay & Stone Ware Works, Ltd., with plants in Charlottenburg and other cities in Germany, will establish a large factory in Poughkeepsie, N. Y. F. Behrend, 54 Front street, New York, represents the company.

The Brookside Mills, Knoxville, Tenn., has let contract for the erection of a five-story warehouse, to have a capacity of 10,000 bales of cotton. Automatic sprinklers, wet system, steam heat and electric elevators will be installed.

The Rosevelt Patent Putty Company, with a capital of $1,000,000, has been organized at Covington, Ky. A plant is to be erected which, with machinery, will cost $150,000. Dr. E. E. Schmidt, Wm. A. Rabe and others, incorporators.

The American Pipe & Foundry Company, a recently organized corporation, and backed principally by Atlanta capital, will shortly begin the erection of a large plant at North Birmingham, Ala. E. E. Linthicum is general manager of the company.

The John Stanton Brewing Company, Troy, N. Y., will make extensive improvements, including a distilling and filtration plant, a wash-house and racking room, all machines to be run by electricity, and a new refrigerating machine of 200 tons capacity.

New Catalogs.

Crocker-Wheeler Company, Ampere, N. J. Flyer No. 276, describing and illustrating a new automatic belt-tightening idler.

The David Bell Engineering Works, Buffalo, N. Y. Bulletin No. 805, showing line of "Standard Guide" steam hammers. Illustrated.

The Blaisdell Machinery Company, Bradford, Pa. Bulletin No. 15, illustrating and describing type "A" air compressors. 6x9, pp. 15, paper.

State Manufacturing Company, 36 Michigan street, Cleveland, O. Catalogue describing "Metla-Cota," a new boiler cleaner. 4x6, pp. 16, paper.

Foos Gas Engine Company, Springfield, O. Catalogue No. 16 of gas and gasoline engines adapted to all power purposes. Illustrated. 8x10, pp. 39, paper.

The Ingersoll-Sergeant Drill Company, 11 Broadway, New York. Form No. 52A, entitled "Coal Mining Machinery." Illustrated. 3½x5½, pp. 14, paper.

Philadelphia Gear Works, Philadelphia, Pa. 1905-1906 catalogue of gears. This contains order lists, tables and bevel gear chart. Illustrated. 5x8, pp. 43, paper.

The Electrical Testing Laboratories, Eightieth street and East End avenue, New York. Booklet describing plant and the uses to which it is put. 6x9, pp. 38, paper.

Oskar Nagel, 90-96 Wall street, New York. Catalogue describing the Nagel suction gas producer and the working of a gas-producer plant. Illustrated. 6x9, pp. 11, paper.

Bullard Machine Tool Company, Bridgeport, Conn. Circular B54, giving specifications of 54-inch rapid production boring and turning mill with two swivel heads. Illustrated.

D. J. Kelsey, 77 Livingston street, New Haven, Conn. Circular illustrating and describing new universal square and protractor, new ruling and erasing shield for draftsmen.

Open Coil Heater & Purifier Company, 19-27 West South street, Indianapolis, Ind. Catalogue describing the Stickle open-coil exhaust steam heaters and purifiers. Illustrated. 5x6½, pp. 16, paper.

Industrial Engineering Company of America, 32 Broadway, New York. Booklet telling of the business of this company and some actual results accomplished by some of its members. Illustrated. 6x9, pp. 21, paper.

Baxter D. Whitney & Son, Winchendon, Mass. Booklet giving brief history of the organization and development of this company and describing some of its wood-working machinery. Illustrated. 5½x8, pp. 23, paper.

Buffalo Forge Company, Buffalo, N. Y. Catalogue No. BB5, illustrating and describing "B" volume blowers and exhausters. 3½x6½, pp. 24. Catalogue No. PB5, illustrating and describing steel pressure blowers. 3½x6½, pp. 24.

The Peck Drop Press Works (Miner & Peck Manufacturing Company, proprietors), New Haven, Conn. Catalogue of automatic drop lifter, drop presses for all purposes, blast forges and wind gates. This contains tables and line drawings. 7x9½, pp. 39, paper.

The W. P. Davis Machine Company, Rochester, N. Y. Catalogue "F." This is a very complete catalogue of the different machine tools made by this company, including engine lathes, drill presses, cutting-off machines and key-seaters, and also supplies handled by them. It is bound in cloth, contains 400 pages, 6x9½; is well illustrated, and will be sent to those interested on request.

The Brown Hoisting Machinery Company, Cleveland, O. 1905 catalogue of "Brownhoist" patent automatic hoisting and conveying appliances. This is a very handsome and

comprehensive catalogue, printed on heavy coated paper and containing fine half-tone illustrations of the various types of machines. It also contains directions for making inquiries and ordering. 9x12, pp. 199, cloth.

Yale & Towne Manufacturing Company, 9-15 Murray street, New York. Catalogue No. 18, entitled "Locks and Hardware." This contains over 200 pages, 6x9, bound in green board covers with red cloth back, has a glossary of technical terms and other interesting data. It is profusely illustrated and is intended for general distribution among hardware dealers and those having to do with building.

Miscellaneous Wants.

Advertisements will be inserted under this head at 25 cents a line each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Caliper cat. free. E. G. Smith, Columbia, Pa.

Punches & dies. Wal.M.Wks.,Waltham,Mass.

Will buy or pay royalty for good patented machine or tool. Box 282, AMER. MACH.

Light and fine mach'y to order; models and elec. work specialty. E. O. Chase, Newark, N. J.

Wanted—Patented specialties of merit to manufacture and market. Power Specialty Co., 500 Washington ave., Detroit, Mich.

Work wanted for a Cleveland automatic lathe; handles 2 in. and under. The Earle Gear & Machine Co., 141 Oxford st., Philadelphia.

Clock work and intricate mechanical instruments; meter counters, water, gas or electric; recording devices; special movements to order. D. S. Plumb, 57 E. Park st., Newark, N. J.

One second-hand combination tilting table pattern shop saw, also 26 or 28 in. thickness planer; must be in good condition and low price. Address Dayton Pattern Works, Dayton, O.

For Sale.

For Sale by the Inventor—U. S. patent No. 786,824; will consider partnership proposition with services included. Address "R. C. L., care AMERICAN MACHINIST.

Business Opportunities.

Will give partner with capital half interest for construction of model; machine very useful and will bring big profits. Address Box 729, AMERICAN MACHINIST.

For Sale—Pattern business, clearing $5,000 yearly; established 12 years; good location, in Greater New York. Information given and arrangements made with right party. Box 716, AMERICAN MACHINIST.

I have a marine specialty needed by every yacht and vessel. Already advertised and orders for over $1,000, yielding large net profits, actually in hand. No competition. Want partner with $5,000 to $10,000 to establish plant and manufacture. Only bona fide answers will be acknowledged. Box 700, AMER. MACH.

Wants.

Situation and Help Advertisements only inserted under this head. Rate 25 cents a line for each insertion. About six words make a line. No advertisements under two lines accepted, and no advertisements abbreviated. The cash and copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded; but replies will not be returned. If not forwarded they will be destroyed without notice. Original letters of recommendation or other papers of value should not be enclosed to unknown correspondents. Only bona fide situation want or help want advertisements inserted under this heading. Agency advertisements must be placed under Miscellaneous Wants.

Situations Wanted.

Classification indicates present address of advertiser, nothing else.

CONNECTICUT.

Manufacturers—Is your output satisfactory? I am a man of 20 years' experience, thoroughly conversant with best shop methods and successful in handling large forces of men. I would consider a position of responsibility with reliable concern. Address "Hustler, Age 37," care AMER. MACHINIST.

INDIANA.

Superintendent; age 35; practical machinist; natural ability and wide experience, handling men and reducing costs. Box 713, A. M.

IOWA.

Foreman patternmaker, desiring to make a change, strictly temperate, best reference, would accept steady position at the bench. Address "Patterns," care AMER. MACHINIST.

MASSACHUSETTS.

An experienced machine shop foreman on engines and electrical machinery desires position. Box 678, AMERICAN MACHINIST.

MICHIGAN.

Mechanical and electrical engineer, expert in forge shop and furnace construction, technical graduate, 6 years' general engineering experience, desires a change. Box 714, A. M.

NEW JERSEY.

Mechanical draftsman, 32, German, technical graduate, wishes position. Box 730, A. M.

Mechanical draftsman desires situation; first class on jigs and tools. Address "W.," care AMERICAN MACHINIST.

Strictly high-grade toolroom foreman, with designing ability of modern tools, jigs and fixtures. Box 710, AMERICAN MACHINIST.

Pattern foreman wants position; experienced, practical, energetic, up-to-date man on all work; good executive; best references. Address Box 704, AMERICAN MACHINIST.

Draftsman; technical, practical; well acquainted with tools, jigs and fixtures; 10 years' shop, drawing experience and 4 years as shop foreman; also well acquainted with eletcricity. Box 709, AMERICAN MACHINIST.

A competent mechanical engineer seeks a position as chief draftsman and superintendent with a progressive concern, to design and manufacture a line of engines, pumps, hydraulic machinery or complete power plants. Address "Thorough," care AMER. MACHINIST.

NEW YORK.

Experienced cost clerk desires position. Box 679, AMERICAN MACHINIST.

Draftsman, up to date, seeks position. Box 736, AMERICAN MACHINIST.

Mechanical draftsman wishes position. Address Box 694, AMERICAN MACHINIST.

Thoroughly competent mechanical superintendent desires change. Box 732, AM. M.

Mechanical draftsman, machine shop experience, desires position. Box 738, AM. M.

Experienced mechanical draftsman (32) wants position. Box 705, AMER. MACHINIST.

Draftsman, mechanical, with 7 years' experience, desires steady position. Box 727, AMERICAN MACHINIST.

Mechanical draftsman, having 6 years' experience, together with 4 years' practical shop work, desires position. Box 734, AM. M.

Position by designing mechanical draftsman, experienced on automatic machinery. Address Box 706, AMERICAN MACHINIST.

Position by expert operator on semi-auto. turret lathe; will take charge or demonstrate; can devise tool equipment. Box 702, AM. M.

Superintendent wishes to make a change; experience steam, gas, automobile, general machinery. Box 725, AMERICAN MACHINIST.

Situation wanted by a first-class mechanical draftsman; 15 years' experience in air compressors, Corliss and Meyer valve engines. Address Box 719, AMERICAN MACHINIST.

A1 mechanical draftsman, good machinery designer, 7 years' experience, college graduate, wants steady position with good concern; references; city. Box 731, AM. M.

Technical graduate, commercial and drafting experience, desires position as assistant to superintendent or manager in a manufacturing concern. Address Box 707, AM. M.

Toolmaker, age 34 years, wants position, foreman; 17 years' experience; had charge of present position 2 years; best reference; manufacturing or toolroom. Box 715, AM. M.

Machine shop foreman, experienced in modern production and management, high-grade duplicate and general machinery, expert machinist, desires responsible position. Box 737, AMERICAN MACHINIST.

Position as superintendent or general foreman of machine shop; experienced and competent man, now holding position of responsibility; good reason for seeking change; will go anywhere; references. Box 721, AM. M.

Wanted—Position as foreman of toolroom or assistant superintendent, by experienced toolmaker; large experience on jigs and fixtures in the United States, England and Germany; at present employed as toolmaker and instructor on jigs and fixtures; age 39; good habits; open for engagement Nov. 6. Address "Hustler," care AMERICAN MACHINIST.

In Greater N. Y. or vicinity, the superintendency or mechanical supervision of some good, progressive manufacturing establishment, by a man of rare abilities and exceptional qualifications, in the prime of a healthy life (38 years of age); heavy, medium or light manufacturing; practically familiar with all details of mechanical production of to-day; a cost-reducer and systematizer and all-round expert in the factory; have an absolutely clean record, with exceptional executive ability and long experience. Unless you mean business and are willing to pay a salary commensurate with value received, do not answer this. Address Box 634, AMER. MACH.

PENNSYLVANIA.

Foreman patternmaker, accustomed to high-speed and four-valve engine and general work, desires change; 8 years foreman. Address "M. E.," care AMERICAN MACHINIST.

Drafting instructor; thoroughly experienced in practical and theoretical machine design; graduate of engineering course in technical school. Box 712, AMERICAN MACHINIST.

Foreman; experience, special and automatic machinery, punches and dies, sub-pressed dies, jigs, fixtures, general work; systematic; 35 years old; best of references. Box 728, A. M.

Superintendent, with executive ability and experienced in modern metal manufacture; toolmaker, with technical education; highest references from present employers. Box 724, AMERICAN MACHINIST.

Mechanical and architectural engineer and draftsman is open for engagement; Corliss engines, blowing and pumping engines, gas engines, power stations; competent to take charge. Address Box 630, AMER. MACHINIST.

Help Wanted.

Classification indicates present address of advertiser, nothing else.

CANADA.

Wanted—General draftsman; one familiar with turbine water-wheel, sawmill and pulp mill machinery design; state age and experience. Apply to Box 650, AMER. MACHINIST.

CONNECTICUT.

Wanted—First-class blacksmith, accustomed to machine forging and use of steam hammer; state age and wages expected; none but first-class men need apply. Box 623, AM. MACH.

ILLINOIS.

Foreman for sheet metal works in Chicago, capable of taking charge of shop employing 100 to 200 men, and working from No. 27 iron up to ¼ plate; must be up to date, familiar with all sheet metal working tools, able to lay out; in answering, state past experience, present occupation, wages and reference. Address Box 643, AMERICAN MACHINIST.

MASSACHUSETTS.

Wanted—Diemakers on small work. Apply to J. W. Lindley, American Optical Co., Southbridge, Mass.

Wanted—Experienced operators on Fellows gear shaper, Gleason planer, Jones & Lamson and turret screw machines. Boston Gear Works, Boston, Mass.

Man of experience in similar work, to organize and maintain an employment bureau in connection with our works. B. F. Sturtevant Co., Hyde Park, Mass.

MICHIGAN.

Wanted—Man with technical training and shop and drafting-room experience, to teach shop drafting and machine tool design; do not apply unless familiar with modern shop methods; full particulars required; $1,200 annually for 9 months' work. Box 720, A. M.

MINNESOTA.

Wanted—First-class tool and die makers, capable of doing small, accurate work. Address, with references, G. F. Kriesel, Minneapolis, Minn.

NEW HAMPSHIRE.

Brass molder who understands melting, to take charge of small brass foundry; give references and pay expected. Box 701, A. M.

NEW JERSEY.

Wanted—Good toolmaker and machinist with experience; state line of work, age, salary expected. Address "P. W. C.," care A. M.

Lathe, planer and boring mill operators wanted for night shift; those accustomed to machine tool work preferred; steady work and good pay to good men. Address the Pond Machine Tool Co., Plainfield, N. J.

Wanted—Several first-class diemakers on high-grade work; sub-press diemakers preferred; steady work and good wages for good workmen; no labor trouble. Sloan & Chace Mfg. Co., 297 Washington st., Newark, N. J.

Wanted—Foreman; experienced man to take charge of brass shop, manufacturing valves, fittings and plumbers' specialties; give full particulars as to age, experience, salary last received, etc. Box 717, AM. M.

NEW YORK.

Wanted—Tool and gage makers; state age, experience and wages expected. Box 733, AMERICAN MACHINIST.

Wanted—Draftsman; experienced on laying out machinery and equipment preferred; reply at once, stating age, experience and salary expected. Box 711, AMER. MACHINIST.

Machinists for floor work; must be first-class men who will appreciate steady employment; open shop; 9 hours per day; wages $2.50. Address Box 708, AMER. MACHINIST.

Wanted—Several A1 mechanical draftsmen; only those having had 3 or more years' practical experience need apply. Engineer in Charge, Drafting Department, General Electric Co., Schenectady, N. Y.

Machine shop foreman; man used to interchangeable work and high-speed steel machining; no heavy work; advantage to speak French; state experience, references and salary; confidential. Box 735, AMER. MACH.

Wanted—In a large manufactory, a skillful mechanical draftsman of practical experience and good executive ability; give full particulars as to qualifications, experience and terms of service. "D. G. N.," care AMER. MACH.

Wanted—Immediately, several expert designers, experienced in designing jigs, dies and fixtures for small machine manufacture, also first-class toolmakers for the same work. Address P. O. Drawer No. 7, Syracuse, N. Y.

Wanted—Name and address of a former student at M. I. T who answered an advertisement in the AMERICAN MACHINIST last January for instructor in patternmaking. Address "W. L. A., care AMERICAN MACHINIST.

Several draftsmen wanted; location, N. Y. city; original designing ability not essential; good positions to good men who are quick and accurate at dimensions; state age, experience, nationality and salary expected. Box 666, AMERICAN MACHINIST.

Wanted—Superintendent to take charge of an established and up-to-date plant manufacturing a line of A1 machine tools; must have push, energy and good executive ability, also be well up in modern machine shop practice; only men of ability need apply; state age, experience, salary expected, with references; all correspondence will be treated strictly confidential. Address Box 726, AM. MACH.

OHIO.

Draftsman, experienced in steam shovel and dredge work. Address by letter, The Vulcan Iron Works Co., Toledo, Ohio.

First-class machinists, used to close interchangeable work for lathe, milling machine and bench in an automobile factory. Box 723, AMERICAN MACHINIST.

Wanted—Superintendent for factory employing 30 to 40 men, manufacturing woodworking machinery, in Ohio; must be experienced in manufacturing this class of machinery and able to install cost system. Box 718, AMERICAN MACHINIST.

General foreman wanted by a concern manufacturing electric cranes; 40 to 60 men; party must be an experienced machine and floor hand; would prefer one who is familiar with crane or engine work; give age, past and present employers, wages, etc.; all replies will be treated strictly confidential Box 669, AMERICAN MACHINIST.

PENNSYLVANIA.

Draftsman wanted at $2 to $3.50 per day; location, eastern Pennsylvania. Reply to "Machine Tools," care AMER. MACHINIST.

Wanted—Good diemaker for sheet metal stampings; state experience and wages desired. McDowell Manufacturing Co., 541 Wood st., Pittsburg, Pa.

Wanted—Experienced draftsmen in electrical apparatus, such as generators, motors and switchboards; only first-class men need apply; state experience and salary expected. Address Box 703, AMERICAN MACHINIST.

Wanted—Machinists and patternmakers. We are constantly adding to our force, and invite applications from machinists and patternmakers, preferably those accustomed to engine work. Shepherd Engineering Company, Franklin, Pa.

Foreman to take charge of modern equipped machine shop; 100 men; must be accustomed to modern methods of rapid production in a miscellaneous class of work; reply promptly, giving age, experience and salary expected. Address "X. Y.," care AMERICAN MACHINIST.

WEST OF MISSISSIPPI.

Clarinet or 'cello player wanted for small pleasure orchestra; permanent employment for first-class mechanical draftsman or good warehouse stock clerk; location, Tennessee. Address Box 658, AMERICAN MACHINIST.

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Vandyck Churchill Co., New York.
Waterbury Farrel Fdry. & Mach. Co., Waterbury, Conn.
Webster & Perks Tool Co., Springfield, O.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Books, Mechanical
American School of Correspondence, Chicago, Ill.
Henley Pub. Co., Norman W., New York.
Hill Pub. Co., New York.
Wiley & Sons, Jno., New York.

Boosters
C & C Elect. Co., New York.
Crocker-Wheeler Co., Ampere, N. J.
General Elec. Co., New York.
Sprague Elec. Co., New York.
Stanley G. I. Elec. Mfg. Co., Pittsfield, Mass.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Boring and Drilling Machines, Horizontal
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Beaman & Smith Co., Provi., R. I.
Betts Mach. Co., Wilmington, Del.
Binsse Mach. Co., Newark, N. J.
Boynton & Plummer, Worcester, Mass.
Dallett Co., Thos. H., Phila., Pa.
Detrick & Harvey Mach. Co., Baltimore, Md.
Draper Mach. Tool Co., Worcester, Mass.
Fitchburg Machine Works, Fitchburg, Mass.
Fosdick Mach. Tool Co., Cin., O.
Gisholt Mach. Co., Madison, Wis.
Hill, Clarke & Co., Boston, Mass.

Boring and Drilling Machines, Horizontal—*Cont'd*
Lucas Mach. Tool Co., Cleve., O.
McCabe, J. J., New York.
Motch & Merryweather Machinery Co., Cleveland, O.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Pawling & Harnischfeger, Milwaukee, Wis.
Prentiss Tool & Supply Co., New York.
Ridgway Mach. Tool Co., Ridgway, Pa.
Springfield Mch. Tool Co., Springfield, O.
Vandyck Churchill Co., New York.
Warner & Swasey Co., Cleveland, Ohio.

Boring and Turning Mills
American Tool Wks. Co., Cin., O.
Baush Mach. Tool Co., Springfield, Mass.
Bertram & Sons Co., Ltd., John, Dundas, Ont., Canada.
Betts Mach. Co., Wilmington, Del.
Bullard Mach. Tool Co., Bridgeport, Conn.
Colburn Mch. Tool Co., Franklin, Pa.
Gisholt Mach. Co., Madison, Wis.
Hill, Clarke & Co., Boston, Mass.
King Mach. Tool Co., Cincin., O.
Niles-Bement-Pond Co., New York.
Poole Co., J. Morton, Wilmington, Del.
Prentiss Tool & Supply Co., New York.
Ridgway Mach. Tool Co., Ridgway, Pa.
Vandyck Churchill Co., New York.
Warner & Swasey Co., Cleveland, Ohio.

Cabinets, Tool
Armstrong Bros. Tool Co., Chicago, Ill.

Calipers
Athol Machine Co., Athol, Mass.
Starrett Co., L. S., Athol, Mass.

Cams
Boston Gear Works, Boston, Mass.

Carborundum
See Grinding Wheels.

Castings, Brass
Nolte Brass Co., Springfield, O.
Phosphor Bronze Smelting Co., Philadelphia, Pa.

Castings, Die Molded
Franklin Mfg. Co., Syracuse, N. Y.

Castings, Iron
Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.
Farrel Fdry. & Mach. Co., Ansonia, Conn.
Massey Mach. Co., Watertown, N. Y.
U. S. Foundry & Sales Co., South Norwalk, Conn.

Castings, Steel
Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.
Farrel Fdry. & Mach. Co., Ansonia, Conn.

Catalogue Makers
Binner-Wells Co., Chicago, Ill.

Cement, Cast Steel
Clark Cast Steel Cement Co., Shelton, Conn.

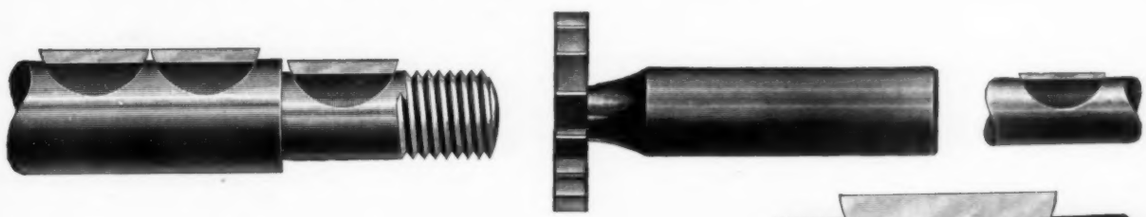
Centering Machines
Hendey Mach. Co., Torrington, Conn.
Phoenix Mfg. Co., Hartford, Ct.
Pratt & Whitney Co., Hartford, Conn.
Whiton Machine Co., D. E., New London, Conn.

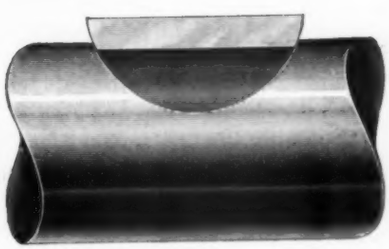
Centers, Planer
New Haven Mfg. Co., New Haven, Conn.
Pratt & Whitney Co., Hartford, Conn.

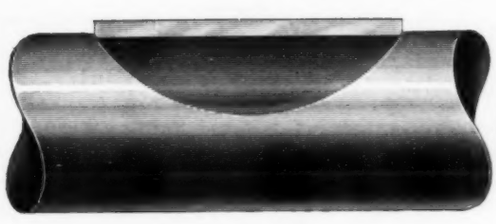
Chains, Driving
Baldwin Chain & Mfg. Co., Worcester, Mass.
Boston Gear Works, Boston, Mass.
Diamond Chain & Mfg. Co., Indianapolis, Ind.
Jeffrey Mfg. Co., The, Columbus, Ohio.
Link Belt Engr. Co., Phila., Pa.
Morse Chain Co., Trumansburg, N. Y.
Whitney Mfg. Co., Hartford, Ct.

Chucking Machines
American Tool Works Co., Cincinnati, O.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Automatic Mach. Co., Cleveland, O.
Draper Mach. Tool Co., Worcester, Mass.
Gisholt Mach. Co., Madison, Wis.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Potter & Johnston Mach. Co., Pawtucket, R. I.
Warner & Swasey Co., Cleveland, Ohio.
Windsor Mach. Co., Windsor, Vt.

Chucks, Drill
Almond Mfg. Co., T. R., Brooklyn, N. Y.
Brown & Co., R. H., New Haven, Conn.
Cleveland Twist Drill Co., Cleveland, O.
Cushman Chuck Co., Hartford, Ct.
Goodell-Pratt Co., Greenfield, Mass.
Horton & Son Co., The E., Windsor Locks, Conn.
Jacobs Mfg. Co., Hartford, Conn.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Niles-Bement-Pond Co., New York.
Pratt Chuck Co., Frankfort, N. Y.
Standard Tool Co., Cleveland, O.
Trump Bros. Mach. Co., Wilmington, Del.







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Gisholt Mach. Co., Madison, Wis.
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Horton & Son Co., The E., Windsor Locks, Conn.
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Skinner Chuck Co., New Britain, Conn.
Whiton Mach. C., D. E., New London, Conn.

Chucks, Planer
Niles-Bement-Pond Co., New York.
Skinner Chuck Co., New Britain, Conn.

Chucks, Split
Faneuil Watch Tool Co., Boston, Mass.

Circuit Breakers
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Cresson Co., Geo. V., Phila., Pa.
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New Haven Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Reeves Pulley Co., Columbus, Ind.
Wood's Sons, T. B., Chambersburg, Pa.

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Compound, Pipe Joint
Dixon Crucible Co., Jos., Jersey City, N. J.

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Bury Compressor Co., Erie, Pa.
Christensen, N. A., Milwaukee, Wis.
Curtis & Co. Mfg. Co., St. Louis, Mo.
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Independent Pneumatic Tool Co., Chicago, Ill.
Ingersoll-Sergeant Drill Co., New York.
International Steam Pump Co., New York.
Rand Drill Co., New York.

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Evans Friction Cone Co., Boston, Mass.

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Standard Connecting Rod Co., Beaver Falls, Pa.
Tindel-Morris Co., Eddystone, Pa.

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Blanchard Mach. Co., Boston, Mass.

Controllers and Starters, Electric Motor
Cutler-Hammer Clutch Co., Milwaukee, Wis.
General Elec. Co., New York.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Coping Machines
Long & Allstatter Co., Hamilton, Ohio.
Niles-Bement-Pond Co., New York.

Correspondence Schools
See Schools, Correspondence.

Cost Systems
Wright, Harold O., New York.

Counterbores
Slocomb Co., J. T., Provi., R. I.

Countershafts
Almond Mfg. Co., T. R., Brooklyn, N. Y.
Builders' Iron Fdry., Prov., R. I.

Countershafts, Friction
Wilmarth & Morman Co., Grand Rapids, Mich.

Counting and Printing Wheels
Franklin Mfg. Co., Syracuse, N. Y.

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Almond Mfg. Co., T. R., Brooklyn, N. Y.
Caldwell & Son Co., H. W., Chicago, Ill.
Cresson Co., Geo. V., Phila., Pa.
Davis Mach. Co., W. P., Rochester, N. Y.
Nicholson & Co., W. H., Wilkesbarre, Pa.
Niles-Bement-Pond Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Standard Gauge Steel Co., Beaver Falls, Pa.
Wood's Sons, T. B., Chambersburg, Pa.

Cranes
Brown Hoisting Mach. Co., New York.
Case Mfg. Co., Columbus, O.
Chambersburg Engineering Co., Chambersburg, Pa.
Cleveland Crane & Car Co., Wickliffe, O.
Crescent Forgings Co., Oakmont, Pa.
Curtis & Co. Mfg. Co., St. Louis, Mo.
General Pneumatic Tool Co., Montour Falls, N. Y.
Maris Bros., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Northern Engineering Works, Detroit, Mich.
Obermayer Co., S., Cincinnati, O.
Pawling & Harnischfeger, Milwaukee, Wis.
Sellers & Co., Wm., Phila., Pa.
Vandyck Churchill Co., New York.

Crank Pin Turning Machines
Niles-Bement-Pond Co., New York.
Underwood & Co., H. B., Philadelphia, Pa.

Crank Shafts
Erie Forge Co., Erie, Pa.
Standard Connecting Rod Co., Beaver Falls, Pa.
Tindel-Morris Co., Eddystone, Pa.

Crucibles
Dixon Crucible Co., Jos., Jersey City, N. J.

Cupolas, and Ladles, Foundry
Northern Engineering Works, Detroit, Mich.
Obermayer Co., S., Cincinnati, O.
Paxson Co., J. W., Phila., Pa.
Stevens, F. B., Detroit, Mich.

Cut Meters
Warner Instrument Co., Beloit, Wis.

Cutters, Milling
Adams Co., Dubuque, Iowa.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Boker & Co., Hermann, New York.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Twist Drill Co., Cleveland, O.
Ingersoll Milling Mach. Co., Rockford, Ill.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rogers, John M., Boat, Gauge & Drill Works, Gloucester City, N. J.
Standard Tool Co., Cleveland, O.
Union Twist Drill Co., Athol, Mass.
Whitney Mfg. Co., Hartford, Ct.

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Bignall & Keeler Mfg. Co., Edwardsville, Ill.
Brown & Sharpe Mfg. Co., Providence, R. I.
Davis Mach. Co., W. P., Rochester, N. Y.
Hurlbut-Rogers Mach. Co., South Sudbury, Mass.
Newton Mach. Tool Wks., Philadelphia, Pa.

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Pratt & Whitney Co., Hartford, Conn.
Vandyck Churchill Co., New York.

Cutting-off Tools
Armstrong Bros. Tool Co., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn.
Fitchburg Machine Works, Fitchburg, Mass.
O. K. Tool Holder Co., Shelton, Conn.
Pratt & Whitney Co., Hartford, Conn.

Diamond Tools
Dickinson, Thos. L., New York.

Dies, Sheet Metal
American Tube & Stamping Co., Bridgeport, Conn.
Bliss Co., E. W., Brooklyn, N. Y.
Niagara Mach. & Tool Wks., Buffalo, N. Y.

Dies, Threading, Opening
Errington, F. A., New York.
Geometric Tool Co., New Haven, Conn.
Jones & Lamson Mch. Co., Springfield, Vt.
Pratt & Whitney Co., Hartford, Conn.
Swaine Co., Fred J., St. Louis, Mo.

Drafting Machines
Universal Drafting Mach. Co., Cleveland, O.

Drawing Boards and Tables
Keuffel & Esser Co., New York.
Rich, J. & G., Philadelphia, Pa.

Drawing Materials
Alteneder & Sons, Theo., Philadelphia, Pa.
Keuffel & Esser Co., New York.

Drilling Machines, Bench
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Boynton & Plummer, Worcester, Mass.
Pratt & Whitney Co., Hartford, Conn.

Drilling Machines, Boiler
American Tool Wks. Co., Cin., O.
Bickford Drill & Tool Co., Cincinnati, O.
Boynton & Plummer, Worcester, Mass.
Dallett Co., Thos. H., Phila., Pa.
Niles-Bement-Pond Co., New York.

Drilling Machines, Multiple Spindle
American Tool Wks. Co., Cin., O.
Baker Bros., Toledo, O.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Baush Mach. Tool Co., Springfield, Mass.
Bickford Drill & Tool Co., Cincinnati, O.
Dallett Co., Thos. H., Phila., Pa.
Fenn-Sadler Mach. Co., Hartford, Conn.
Foote, Burt & Co., Cleveland, O.
Fosdick Mach. Tool Co., Cin., O.
Garvin Mach. Co., New York.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
McCabe, J. J., New York.
Newton Mach. Tool Works, Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.

Drilling Machines, Pneumatic
Independent Pneumatic Tool Co., Chicago, Ill.

Drilling Machines, Portable
Coates Clipper Mfg. Co., Worcester, Mass.
Dallett Co., Thos. H., Phila., Pa.
Hisey-Wolf Mch. Co., Cincin., O.
Niles-Bement-Pond Co., New York.

Drilling Machines, Radial
American Tool Wks. Co., Cin., O.
Baush Mach. Tool Co., Springfield, Mass.
Bickford Drill & Tool Co., Cincinnati, O.
Dreses Mach. Tool Co., Cin., O.
Fairbanks Co., New York.
Fitchburg Machine Works, Fitchburg, Mass.
Fosdick Mach. Tool Co., Cin., O.

Drilling Machines, Radial *Continued*
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hill, Clarke & Co., Boston, Mass.
McCabe, J. J., New York.
Mueller Mach. Tool Co., Cin., O.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Ridgway Mach. Tool Co., Ridgway, Pa.
Vandyck Churchill Co., New York.

Drilling Machines, Turret
Niles-Bement-Pond Co., New York.

Drilling Machines, Upright
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Baker Bros., Toledo, O.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Bertram & Sons Co., Ltd., John, Dundas, Ont., Canada.
Boynton & Plummer, Worcester, Mass.
Cincinnati Mach. Tool Co., Cincinnati, O.
Dallett Co., Thos. H., Phila., Pa.
Davis Mach. Co., W. P., Rochester, N. Y.
Fairbanks Co., New York.
Fenn-Sadler Mach. Co., Hartford, Conn.
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McCabe, J. J., New York.
Marshal & Huschart Mchry. Co., Chicago, Ill.
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Prentiss Tool & Supply Co., New York.
Sibley Machine Tool Co., South Bend, Ind.
Vandyck Churchill Co., New York.
Whitcomb-Blaisdell Machine Tool Co., Worcester, Mass.
Whitney Mfg. Co., Hartford, Conn.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Drills, Center
Pratt & Whitney Co., Hartford, Conn.
Slocomb Co., J. T., Providence, R. I.
Standard Tool Co., Cleveland, O.

Drills, Pneumatic
Cleveland Pneu. Tool Co., Cleveland, O.
General Pneu. Tool Co., Montour Falls, N. Y.
Ingersoll-Sergeant Drill Co., New York.
International Steam Pump Co., New York.
Niles-Bement-Pond Co., New York.
Rand Drill Co., New York.

Drills, Hand
Dallett Co., Thos. H., Phila., Pa.
Hisey-Wolf Mach. Co., Cincin., O.
Niles-Bement-Pond Co., New York.

Drills, Rail
Foote, Burt & Co., Cleveland, O.
Niles-Bement-Pond Co., New York.

Drills, Ratchet
Billings & Spencer Co., Hartford, Conn.
Parker Co., Chas., Meriden, Conn.
Pratt & Whitney Co., Hartford, Conn.
Standard Tool Co., Cleveland, O.

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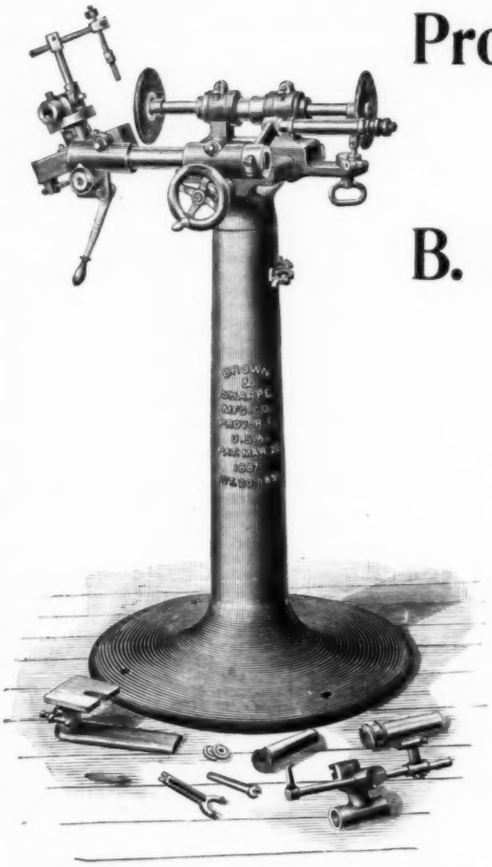
Roth Bros. & Co., Chicago, Ill.
Sprague Elec. Co., New York.

BROWN & SHARPE MFG. CO.,

PROVIDENCE, R. I., U. S. A.



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A Necessity in Every Machine Shop.

B. & S. Cutter Grinding Machines

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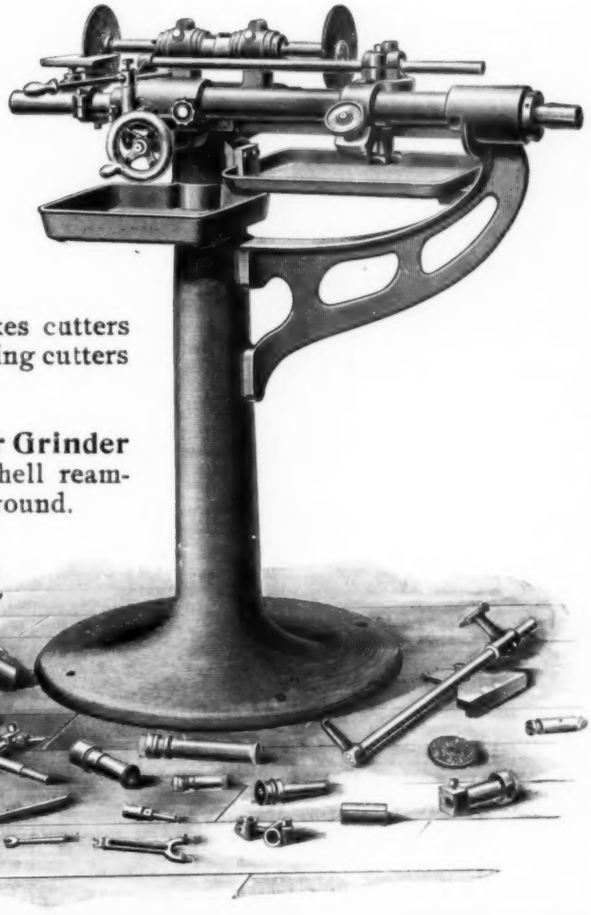

No. 2 Cutter Grinding Machine takes cutters to 6" in length and 6" in diameter; thin milling cutters or saws to 24" in diameter.

No. 3 Universal Cutter and Reamer Grinder takes 18" between centres and cutters, and shell reamers to 6" diameter and 7" in length can be ground.

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Emery Wheel Dressers
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Brown-Cochran Co., Lorain, O.
Columbus Mach. Co., Columbus, O.
Foos Gas Engine Co., Springfield, Ohio.
Jacobson Mach. & Mfg. Co., Warren, Pa.
Mietz, August, New York.
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Olds Gasoline Engine Wks., Lansing, Mich.
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Mietz, August, New York.

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Binner-Wells Co., Chicago, Ill.

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Gorton Mach. Co., Geo., Racine, Wis.

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Philadelphia Bourse, Phila., Pa.

Extractor
Oil & Waste Saving Mach. Co., Philadelphia, Pa.

Fans, Electric
General Electric Co., New York.
Northern Elec. Mfg. Co., Madison, Wis.
Sprague Elec. Co., New York.
Sturtevant Co., B. F., Hyde Park, Mass.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

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Ingersoll-Sergeant Drill Co., New York.
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Crescent Forgings Co., Oakmont, Pa.
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Forgings, Hydraulic
Wyman & Gordon, Worcester, Mass.

Forgings, Steel
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Crescent Forgings Co., Oakmont, Pa.
Erie Forge Co., Erie, Pa.
Heppenstall Forge & Knife Co., Pittsburg, Pa.
Tindel-Morris Co., Eddystone, Pa.
Wyman & Gordon, Worcester, Mass.

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Paxson Co., J. W., Phila., Pa.
Stevens, F. B., Detroit, Mich.
Sturtevant Co., B. F., Hyde Park, Mass.

Fuel Economizers
Sturtevant Co., B. F., Boston, Mass.

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American Gas Furnace Co., New York.

Furnaces, Enameling
American Gas Furnace Co., New York.

Furnaces, Gas
Am. Gas Furnace Co., N. Y. City.
Chicago Fexible Shaft Co., Chicago, Ill.
Westmacott Co., J. M., Providence, R. I.

Furnaces, Melting
American Gas Furnace Co., New York.

Furniture, Machine Shop
New Britain Mach. Co., New Britain, Conn.

Gas Blowers and Exhausters
Sturtevant Co., B. F., Boston, Mass.

Gauges, Recording
Bristol Co., Waterbury, Conn.

Gauges, Standard
Brown & Sharpe Mfg. Co., Providence, R. I.
Henry & Wright Mfg. Co., Hartford, Conn.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rogers, John M., Boat, Gauge & Drill Works, Gloucester City, N. J.
Slocomb Co., J. T., Prov., R. I.
Starrett Co., L. S., Athol, Mass.

Gauges, Steam
Lunkenheimer Co., Cincinnati, O.

Gear Cutting Machinery
Adams Co., Dubuque, Iowa.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Bickford Drill & Tool Co., Cin., O.
Brown & Sharpe Mfg. Co., Providence, R. I.
Clough, R. M., Tolland, Conn.
Fellows Gear Shaper Co., Springfield, Vt.
Ganschow, Wm., Chicago, Ill.
Gleason Works, Rochester, N. Y.
Gould & Eberhardt, Newark, N. J.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Whiton Machine Co., D. E., New London, Conn.

Gear Testing Machinery
Gisholt Mach. Co., Madison, Wis.

Gears, Cut
Bilgram, Hugo, Philadelphia, Pa.
Boston Gear Wks., Boston, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Caldwell & Son Co., H. W., Chicago, Ill.
Cresson Co., Geo. V., Phila., Pa.
Davis, Rodney, Philadelphia, Pa.
Earle Gear & Mach. Co., Philadelphia, Pa.
Eberhardt Bros. Mach. Co., Newark, N. J.
Fawcus Mch. Co., Pittsburg, Pa.
Fellows Gear Shaper Co., Springfield, Vt.
Ganschow, Wm., Chicago, Ill.
Gleason Works, Rochester, N. Y.
Grant Gear Works, Boston, Mass.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Horsburgh & Scott Co., The, Cleveland, O.
Massey Mach. Co., Watertown, N. Y.
Messmer Mfg. Co., Ferd., St. Louis, Mo.
New Process Raw Hide Co., Syracuse, N. Y.
Nuttall Co., R. D., Pittsburg, Pa.
Patterson, Gottfried & Hunter, Ltd., New York.
Philadelphia Gear Wks., Philadelphia, Pa.
Sawyer Gear Wks., Cleveland, O.
Simonds Mfg. Co., Pittsburg, Pa.
Syracuse Raw Hide Co., Syracuse, N. Y.
Taylor-Wilson Mfg. Co., Allegheny, Pa.

Gears, Molded
Caldwell & Son Co., H. W., Chicago, Ill.
Farrel Fdry. & Mach. Co., Ansonia, Conn.
Franklin Mfg. Co., Syracuse, N. Y.
Greenwald Co., I. & E., Cincin., O.
Taylor-Wilson Mfg. Co., Allegheny, Pa.

Gears, Rawhide
Boston Gear Wks., Boston, Mass.
Chicago Raw Hide Mfg. Co., Chicago, Ill.
Earle Gear & Mach. Co., Philadelphia, Pa.
Fawcus Mch. Co., Pittsburg, Pa.
Gould & Eberhardt, Newark, N. J.
Horsburgh & Scott Co., Cleveland, Ohio.
New Process Raw Hide Co., Syracuse, N. Y.
Nuttall Co., R. D., Pittsburg, Pa.
Syracuse Raw Hide Co., Syracuse, N. Y.

Gears, Worm
Albro-Clem Elevator Co., Philadelphia, Pa.
Boston Gear Wks., Boston, Mass.
Fawcus Mch. Co., Pittsburg, Pa.

Gears, Worm—*Continued*
Gould & Eberhardt, Newark, N. J.
Grant Gear Works, Boston, Mass.
Morse, Williams & Co., Phila., Pa.
Nuttall Co., R. D., Pittsburg, Pa.
Philadelphia Gear Works, Philadelphia, Pa.
Simonds Mfg. Co., Pittsburg, Pa.
Taylor-Wilson Mfg. Co., Allegheny, Pa.

Generating Sets
Burke Electric Co., Erie, Pa.
Sturtevant Co., B. F., Boston, Mass.

Generators, Gas
American Gas Furnace Co., New York.

Graphite
Dixon Crucible Co., Jos., Jersey City, N. J.
Obermayer Co., S., Cincinnati, O.

Grinders, Center
Coates Clipper Mfg. Co., Worcester, Mass.
Heald Mch. Co., Worcester, Mass.
Hisey-Wolf Mach. Co., Cincin., O.
Mueller Mch. Tool Co., Cin., O.
Niles-Bement-Pond Co., New York.

Grinders, Cock
Windsor Mach. Co., Windsor, Vt.

Grinders, Cutter
Automatic Mach. Co., Greenfield, Mass.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati, O.
Garvin Machine Co., New York.
Gould & Eberhardt, Newark, N. J.
Greenfield Mach. Co., Greenfield, Mass.
Heald Mach. Co., Worcester, Mass.
Hisey-Wolf Mach. Co., Cincin., O.
Niles-Bement-Pond Co., New York.
Norton Emery Wheel Co., Worcester, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rivett-Dock Co., Boston, Mass.

Grinders, Disk
Besly & Co., Chas. H., Chicago, Ill.
Diamond Mach. Co., Provi., R. I.
Heald Machine Co., Worcester, Mass.
Iroquois Mach. Co., New York.
Ransom Mfg. Co., Oshkosh, Wis.
Rowbottom Machine Co., Waterbury, Conn.

Grinders, Drill
Heald Mch. Co., Worcester, Mass.
Niles-Bement-Pond Co., New York.
Standard Tool Co., Cleveland, O.
Wilmarth & Morman Co., Grand Rapids, Mich.

Grinders, Portable
Heald Machine Co., Worcester, Mass.
Hisey-Wolf Mach. Co., Cincin., O.

Grinders, Tool
Armstrong Bros. Tool Co., Chicago, Ill.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Brown & Sharpe Mfg. Co., Providence, R. I.
Diamond Mach. Co., Prov., R. I.
Gisholt Mach. Co., Madison, Wis.
Gould & Eberhardt, Newark, N. J.
Hisey-Wolf Mach. Co., Cincin., O.
Landis Tool Co., Waynesboro, Pa.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Niles-Bement-Pond Co., New York.
Ransom Mfg. Co., Oshkosh, Wis.
Safety Emery Wheel Co., Springfield, O.
Standard Tool Co., Cleveland, O.
Vandyck Churchill Co., New York.
Walker & Co., O. S., Worcester, Mass.
Whitney Mfg. Co., Hartford, Ct.

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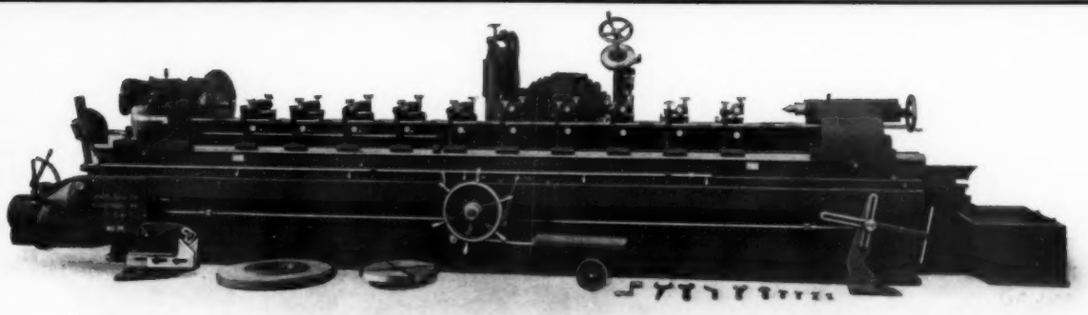
Besly & Co., Chas. H., Chicago, Ill.
Blount Co., J. G., Everett, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Builders' Iron Foundry, Providence, R. I.
Coates Clipper Mfg. Co., Worcester, Mass.
Diamond Mach. Co., Prov., R. I.
Field, Chas. H., Providence, R. I.



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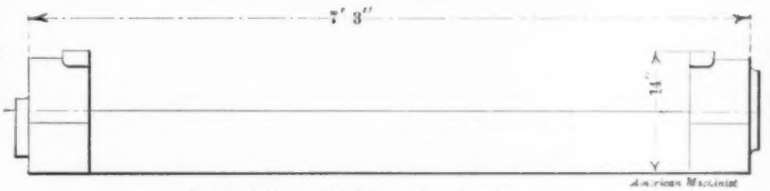

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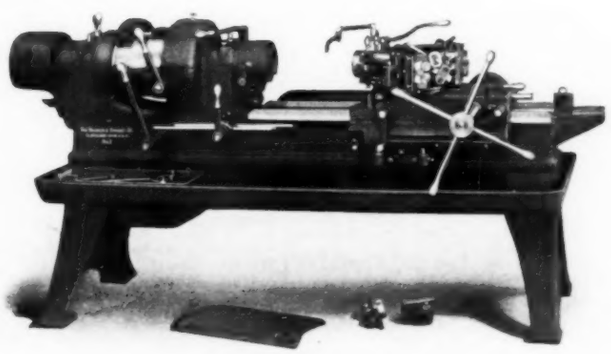

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Niles-Bement-Pond Co., New York.
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Norton Grinding Co., Worcester, Mass.
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Diamond Mach. Co., Prov., R. I.
Hampden Cor. Wheel Co., Brightwood, Mass.
National Corundum Wheel Co., Buffalo, N. Y.
Niles-Bement-Pond Co., New York.
Norton Emery Wheel Co., Worcester, Mass.
Safety Emery Wheel Co., Springfield, O.
Superior Corundum Wheel Co., Waltham, Mass.
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Hammacher, Schlemmer & Co., New York.
Massachusetts Saw Wks., Chicopee, Mass.
Patterson, Gottfried & Hunter, Ltd., New York.
Starrett Co., L. S., Athol, Mass.
West Haven Mfg. Co., New Haven, Conn.

Hack Saws, Power
Fairbanks Co., New Haven.
Hoefer Mfg. Co., Freeport, Ill.
Niles-Bement-Pond Co., New York.
West Haven Mfg. Co., New Haven, Conn.

Hammers, Drop
Billings & Spencer Co., Hartford, Conn.
Bliss Co., E. W., Brooklyn, N. Y.
Chambersburg Engineering Co., Chambersburg, Pa.
Gould & Eberhardt, Newark, N. J.
Merrill Bros., Brooklyn, N. Y.
Miner & Peck Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
Waterbury Farrel Fdry. & Mach. Co., Waterbury, Conn.

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Dallett Co., Thos. H., Phila., Pa.
Independent Pneumatic Tool Co., Chicago, Ill.
Ingersoll-Sergeant Drill Co., New York.
International Steam Pump Co., New York.
Niles-Bement-Pond Co., New York.
Rand Drill Co., New York.

Hammers, Power
Niles-Bement-Pond Co., New York.
Scranton & Co., The, New Haven, Conn.

Hammers, Steam
Bethlehem Fdry. & Mach. Co., So. Bethlehem, Pa.
Chambersburg Engineering Co., Chambersburg, Pa.
Crescent Forgings Co., Oakmont, Pa.
Vandyck Chuchill Co., New Yok.

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Standard Welding Co., Cleve., O.

Hangers, Shafting
Cresson Co., Geo. V., Phila., Pa.
Fairbanks Co., New York.
Hyatt Roller Bearing Co., Harrison, N. J.
Pryibil, P., New York.
Wood's Sons, T. B., Chambersburg, Pa.

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Sturtevant Co., B. F., Hyde Park, Mass.

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Buffalo Forge Co., Buffalo, N. Y.
Sturtevant Co., B. F., Hyde Park, Mass.

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Am. Gas Furnace Co., New York.

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Caldwell & Son Co., H. W., Chicago, Ill.
Cresson Co., Geo. V., Phila., Pa.
Link Belt Engineering Co., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.

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C & C Electric Co., New York.
Cleveland Crane & Car Co., Wickliffe, O.
Curtis & Co. Mfg. Co., St. Louis, Mo.
General Pneu. Tool Co., Montour Falls, N. Y.
Maris Bros., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Northern Engineering Works, Detroit, Mich.
Sprague Electric Co., New York.
Yale & Towne Mfg. Co., New York.

Hoists, Hand
Harrington, Son & Co., Edwin, Philadelphia, Pa.
International Steam Pump Co., New York.
Moore Co., Franklin, Winsted, Conn.
Yale & Towne Mfg. Co., New York.

Hoists, Pneumatic
Curtis & Co. Mfg. Co., St. Louis, Mo.
General Pneumatic Tool Co., Montour Falls, N. Y.
Independent Pneumatic Tool Co., Chicago, Ill.
International Steam Pump Co., New York.
Rand Drill Co., New York.

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Franklin Mfg. Co., Syracuse, N. Y.

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Norton Emery Wheel Co., Worcester, Mass.
Starrett Co., L. S., Athol, Mass.

Indicators, Speed, Peripheral
Warner Instrument Co., Beloit, Wis.

Industrial Railways
Hunt Co., C. W., West New Brighton, N. Y.

Injectors
Desmond-Stephan Mfg. Co., Urbana, O.
International Specialty Co., Detroit, Mich.
Lunkenheimer Co., Cincinnati, O.
Sellers & Co., Wm., Phila., Pa.

Inspection and Tests
Hunt Co., Robt. W., Chicago, Ill.

Instruction Schools
See Schools, Correspondence.

Insurance, Boiler
Hartford Steam Boiler Insp. & Ins. Co., Hartford, Conn.

Iron Filler
Felton, Sibley & Co., Phila., Pa.

Jacks, Hydraulic
Bethlehem Fdry. & Mach. Co., So. Bethlehem, Pa.
Watson-Stillman Co., New York.

Jacks, Planer
Armstrong Bros. Tool Co., Chicago, Ill.

Key Seaters
Baker Bros., Toledo, O.
Chattanooga Mchy. Co., Chattanooga, Tenn.
Davis Mach. Co., W. P., Rochester, N. Y.
Hill-Standard Mfg. Co., Anderson, Ind.
Lapointe Machine Tool Co., Boston, Mass.
Niles-Bement-Pond Co., New York.
Street Bros. Machine Co., Chattanooga, Tenn.
Whitney Mfg. Co., Hartford, Ct.

Keys, Machine
Standard Gauge Steel Co., Beaver Falls, Pa.
Whitney Mfg. Co., Hartford, Ct.

Knurls
Hammacher, Schlemmer & Co., New York.

Lamps, Arc
General Electric Co., N. Y. City.
Gilmore Electric Co., South Boston, Mass.
Stanley G. I. Elec. Mfg. Co., Pittsfield, Mass.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Lamps, Incandescent
General Electric Co., New York.
Stanley G. I. Elec. Mfg. Co., Pittsfield, Mass.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Lathe Attachments
American Tool Wks. Co., Cin., O.
Bradford Machine Tool Co., Cincinnati, O.
Fitchburg Machine Works, Fitchburg, Mass.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Hartford, Conn.

Lathes, Bench
Seneca Falls Mfg. Co., Seneca Falls, N. Y.

Lathe Dogs
Armstrong Bros. Tool Co., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn.
Besly & Co., Chas. H., Chicago, Ill.
Hill-Standard Mfg. Co., Anderson, Ind.
Le Count, Wm. G., So. Norwalk, Conn.
Pratt & Whitney Co., Hartford, Conn.
Tindel-Morris Co., Eddystone, Pa.

Lathes
Automatic Mach. Co., Greenfield, Mass.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Bertram & Sons Co., Ltd., John, Dundas, Ont., Canada.
Blount Co., J. G., Everett, Mass.
Bradford Mach. Tool Co., Cin., O.
Bridgeford Machine Tool Works, Rochester, N. Y.
Bullard Mach. Tool Co., Bridgeport, Conn.
Davis Mach. Co., W. P., Rochester, N. Y.
Diamond Machine Co., Prov., R. I.
Draper Mach. Tool Co., Worcester, Mass.
Dreses Mach. Tool Co., Cincin., O.
Fairbanks Co., New York.
Fitchburg Machine Works, Fitchburg, Mass.
Flather & Co., Nashua, N. H.
Garvin Mach. Co., New York.
Gisholt Machine Co., Madison, Wis.
Greaves, Klusman & Co., Cin., O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hendey Mach. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.

Lathes —*Continued*
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Lodge & Shipley Mach. Tool Co., Cincinnati, O.
McCabe, J. J., New York.
Marshall & Huschart Mchry. Co., Chicago, Ill.
Motch & Merryweather Machinery Co., Cleveland, O.
New Haven Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Ridgway Mach. Tool Co., Ridgway, Pa.
Robbins, L., Worcester, Mass.
Schumacher & Boye, Cincinnati, Ohio.
Sebastian Lathe Co., Cincin., O.
Seneca Falls Mfg. Co., Seneca Falls, N. Y.
Shepard Lathe Co., Cincinnati, O.
Silk Mach. Tool Co., P. P., Cincinnati, O.
Springfield Mch. Tool Co., Springfield, O.
Vandyck Churchill Co., New York.
Von Wyck Mach. Tool Co., Cincinnati, O.
Whitcomb-Blaisdell Mach. Tool Co., Worcester, Mass.

Lathes, Automatic Screw-Threading
Automatic Machine Co., Bridgeport, Conn.
Pratt & Whitney Co., Hartford, Conn.

Lathes, Bench
American Watch Tool Co., Waltham, Mass.
Blount Co., J. G., Everett, Mass.
Faneuil Watch Tool Co., Boston, Mass.
Fenn-Sadler Mach. Co., Hartford, Conn.
Pratt & Whitney Co., Hartford, Conn.
Stark Tool Co., Waltham, Mass.
Waltham Watch Tool Co., Springfield, Mass.

Lathes, Boring
Niles-Bement-Pond Co., New York.

Lathes, Brass
Pratt & Whitney Co., Hartford, Conn.
Springfield Mch. Tool Co., Springfield, O.

Lathes, Wood
Seneca Falls Mfg. Co., Seneca Falls, N. Y.

Letters, Pattern
Butler, A. G., N. Y. City.

Lockers, Clothes
Merritt & Co., Philadelphia, Pa.

Lubricants
Besly & Co., Chas. H., Chicago, Ill.
Dixon Crucible Co., Jos., Jersey City, N. J.

Lubricators
Besly & Co., Chas. H., Chicago, Ill.
Lunkenheimer Co., Cincinnati, O.

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Baird Machy. Co., Pittsburg, Pa.
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Prentiss Tool & Supply Co., New York.
Toomey, Frank, Philadelphia, Pa.
Tuohy Bros., New York.
Vandyck Churchill Co., New York.
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Athol Machine Co., Athol, Mass.
Bemis & Call Hardware & Tool Co., Springfield, Mass.
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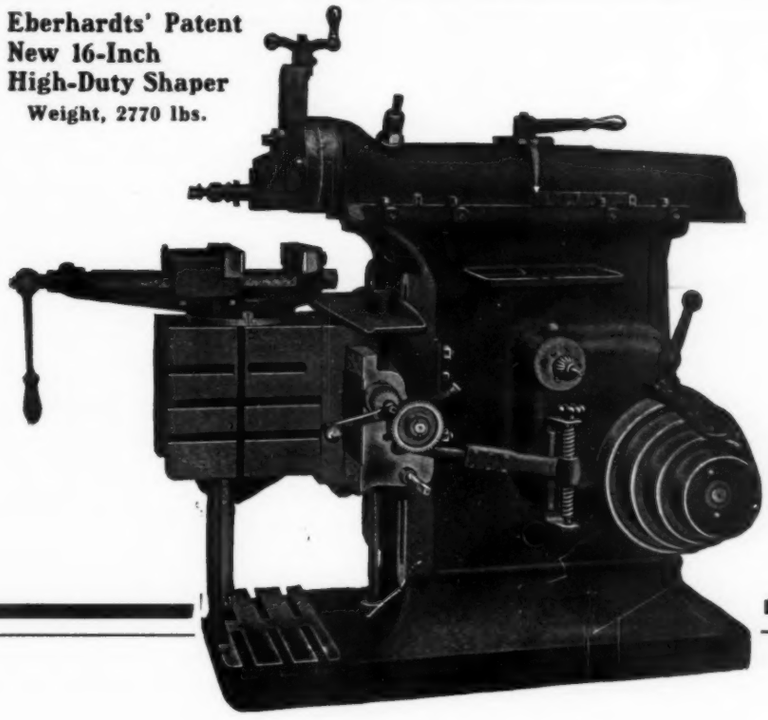

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Pratt & Whitney Co., Hartford, Conn.
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.
Standard Tool Co., Cleveland, O.

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Cincinnati Milling Mach. Co., Cincinnati, O.
Kempsmith Mfg. Co., Milwaukee, Wis.
Niles-Bement-Pond Co., New York.
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Hartford Mach. Screw Co., Hartford, Conn.
Hill, Clarke & Co., Boston, Mass.
Niles-Bement-Pond Co., New York.
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Whitney Mfg. Co., Hartford, Ct.

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Beaman & Smith Co., Prov., R. I.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Cincinnati Mill. Mach. Co., Cincinnati, O.
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Kempsmith Mfg. Co., Milwaukee, Wis.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Hartford, Conn.

Milling Machines, Plain
Adams Co., Dubuque, Iowa.
American Tool Wks. Co., Cin., O.
Beaman & Smith Co., Prov., R. I.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati, O.
Fairbanks Co., New York.
Garvin Mach. Co., New York.
Hendey Mch. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
Kempsmith Mfg. Co., Milwaukee, Wis.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
McCabe, J. J., New York.
Marshall & Huschart Mchry. Co., Chicago, Ill.
Motch & Merryweather Machinery Co., Cleveland, O.
Niles-Bement-Pond Co., New York.
Owen Mach. Tool Co., Springfield, Ohio.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Vandyck Churchill Co., New York.
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Owen Mach. Tool Co., Springfield, Ohio.
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C & C Electric Co., New York.
Coates Clipper Mfg. Co., Worcester, Mass.
Crocker-Wheeler Co., Ampere, N. J.
Electro Dynamic Co., Bayonne, N. J.
General Electric Co., New York.
Jantz & Leist Elec. Co., Cin., O.
Northern Electrical Mfg. Co., Madison, Wis.

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Stanley G. I. Elec. Mfg. Co., Pittsfield, Mass.
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Oil & Waste Saving Mach. Co., Philadelphia, Pa.

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Jenkins Bros., New York.

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New Britain Mach. Co., New Britain, Conn.

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Phosphor Bronze Smelting Co., Philadelphia, Pa.

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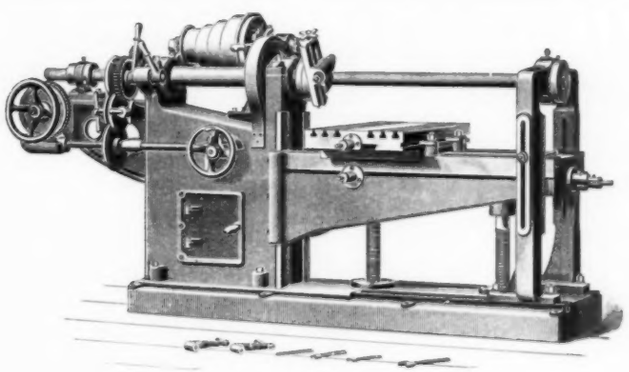

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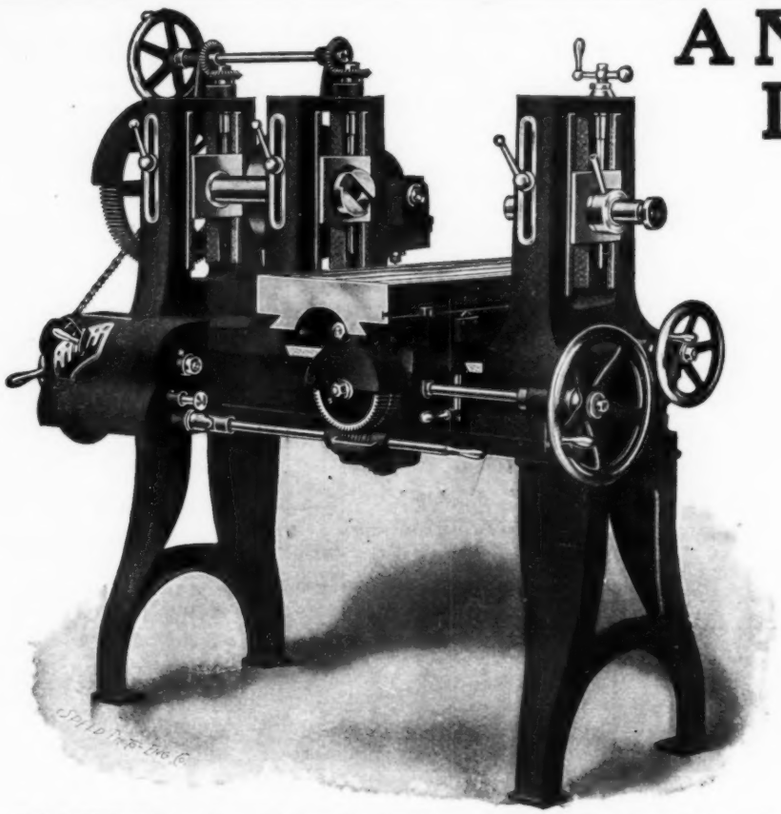

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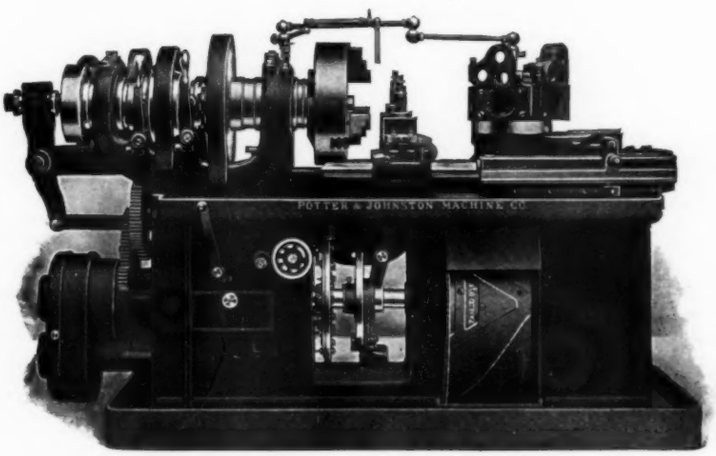

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Lucas Mch. Tool Co., Cleveland, Ohio.
Massey Mach. Co., Watertown, N. Y.
Mechanical Accountant Co., Providence, R. I.
Nutter, Barnes & Co., Boston, Mass.
Pratt & Whitney Co., Hartford, Conn.
Simonds Mfg. Co., Pittsburg, Pa.
Waterbury Farrel Fdry. & Mach. Co., Waterbury, Conn.
Whatley, A. H., Providence, R. I.

Speed Changing Countershafts
Cresson Co., Geo. V., Phila., Pa.
Gisholt Mach. Co., Madison, Wis.
Reeves Pulley Co., Columbus, Ind.
Speed Changing Pulley Co., Indianapolis, Ind.

Sprockets
Baldwin Chain & Mfg. Co., Worcester, Mass.
Boston Gear Wks., Boston, Mass.

Stampings, Sheet Metal
American Tube & Stamping Co., Bridgeport, Conn.

Stampings, Welded
American Tube & Stamping Co., Bridgeport, Conn.
Standard Weding Co., Cleve., O.

Stamps, Steel
Schwerdtle Stamp Co., Bridgeport, Conn.

Steam Specialties
Jenkins Bros., New York.
Lunkenheimer Co., Cincinnati, O.
Nolte Brass Co., Springfield, O.

Steel, Machinery
Baldwin Steel Co., New York.
Boker & Co., Hermann, New York.
Firth-Sterling Steel Co., Demmler, Pa.
Frasse & Co., Peter A., New York.
Kent & Co., Edwin R., Chicago, Ill.
Morton & Co., B. K., Toronto, Canada.
Royal Metal Steel Co., New York.
Standard Gauge Steel Co., Beaver Falls, Pa.
Union Drawn Steel Co., Beaver Falls, Pa.
Ward & Son, Edgar T., Boston, Mass.

Steel, Sheet
American Tube & Stamping Co., Bridgeport, Conn.
Union Drawn Steel Co., Beaver Falls, Pa.
Ward & Son, Edgar T., Boston, Mass.

Steel, Tool
American Tube & Stamping Co., Bridgeport, Conn.
Baldwin Steel Co., New York.
Boker & Co., Hermann, New York.
Firth-Sterling Steel Co., Demmler, Pa.
Frasse & Co., Peter A., New York.
Kent & Co., Edwin R., Chicago Ill.
Morton & Co., B. K., Toronto, Can.
Patterson, Gottfried & Hunter, Ltd., New York.
Phillips & Sons Co., F. R., Philadelphia, Pa.
Royal Metal Steel Co., New York.
Standard Gauge Steel Co., Beaver Falls, Pa.
Union Drawn Steel Co., Beaver Falls, Pa.
Vickers, Sons & Maxim, Sheffield, England.
Ward & Son, Edgar T., Boston, Mass.

Straightening Machinery
Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.
Fitchburg Machine Works, Fitchburg, Mass.
Hartford Mach. Screw Co., Hartford, Conn.
Springfield Mch. Tool Co., Springfield, O.

Straighteners, Hydraulic
Niles-Bement-Pond Co., New York.
Watson-Stillman Co., New York.

Swaging Machines
Excelsior Needle Co., Torrington, Conn.

Switchboards
C & C Electric Co., New York.
General Electric Co., New York.
Triumph Elec. Co., Cincinnati, O.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Switches
Cutler-Hammer Clutch Co., Milwaukee, Wis.
Stanley Elec. Mfg. Co., Pittsfield, Mass.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Tapes, Measuring
Keuffel & Esser Co., New York.
Starrett Co., L. S., Athol, Mass.

Tap Holders
Errington, F. A., New York.

Tapping Machines and Attachments
American Tool Wks. Co., Cin., O.
Baker Bros., Toledo, O.
Beaman & Smith Co., The, Providence, R. I.
Bickford Drill & Tool Co., Cin., O.
Cincinnati Mach. Tool Co., Cincinnati, O.
Errington, F. A., N. Y. City.
Fosdick Mach. Tool Co., Cin., O.
Garvin Mach. Co., New York.
Geometric Tool Co., New Haven, Conn.
Gould & Eberhardt, Newark, N. J.
Hartford Mach. Screw Co., Hartford, Conn.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Webster & Perks Tool Co., Springfield, O.
Whitney Mfg. Co., Hartford, Ct.

Taps and Dies
Bay State Tap & Die Co., Mansfield, Mass.
Besly & Co., Chas. H., Chicago, Ill.
Card Mfg. Co., S. W., Mansfield, Mass.
Carpenter Tap & Die Co., J. M., Pawtucket, R. I.
Cleveland Twist Drill Co., Cleveland, O.
Frasse & Co., Peter A., New York.
Geometric Tool Co., New Haven, Conn.
Hammacher, Schlemmer & Co., New York.
Hart Mfg. Co., Cleveland, O.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Reece Co., E. F., Greenfield, Mass.
Standard Tool Co., Cleveland, O.
Webster & Perks Tool Co., Springfield, O.
Wells Bros. Co., Greenfield, Mass.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Taps, Collapsing
Geometric Tool Co., New Haven, Conn.
Hemming Bros., New Haven, Conn.

Telephones
N. Y. Telephone Co., New York.

Thermit
Goldschmidt Thermit Co., New York.

Thread Cutting Tools
Besly & Co., Chas. H., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn.
Hart Mfg. Co., Cleveland, O.
Pratt & Whitney Co., Hartford, Conn.
Rivett-Dock Co., Boston, Mass.

Time Recorders
Simplex Time Recorder Co., Gardner, Mass.

Tool Holders
Armstrong Bros. Tool Co., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn.
Hill-Standard Mfg. Co., Anderson, Ind.
Hoggson & Pettis Mfg. Co., New Haven, Conn.
O. K. Tool Holder Co., Shelton, Conn.
Pratt & Whitney Co., Hartford, Conn.

Tools, Small
See Machinists' Small Tools.

Transformers and Converters
General Elec. Co., New York.
Stanley G. I. Elec. Mfg. Co., Pittsfield, Mass.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Transmission Machinery
American Pulley Co., Phila., Pa.
Caldwell & Son Co., H. W., Chicago, Ill.
Case Mfg. Co., Columbus, O.
Cresson & Co., Geo. V., Philadelphia, Pa.
Eastern Machinery Co., New Haven, Conn.
Link-Belt Engineering Co., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Pryibil, P., New York.
Reeves Pulley Co., Columbus, Ind.
Speed Changing Pulley Co., Indianapolis, Ind.
Wood's Sons, T. B., Chambersburg, Pa.

Traps, Steam
Sturtevant Co., B. F., Hyde Park, Mass.

Trolleys and Tramways
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Link-Belt Engineering Co., Philadelphia, Pa.
Maris Bros., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Yale & Towne Mfg. Co., New York.

Tubing, Steel
Almond Mfg. Co., T. R., Brooklyn, N. Y.
American Tube & Stamping Co., Bridgeport, Conn.

Turnbuckles
Merrill Bros., Brooklyn, N. Y.

Turret Heads
Almond Mfg. Co., T. R., Brooklyn, N. Y.

Turret Machines
Automatic Mach. Co., Greenfield, Mass.
Bradford Mach. Tool Co., Cincinnati, O.
Brown & Sharpe Mfg. Co., Providence, R. I.
Bullard Mach. Tool Co., Bridgeport, Conn.
Dreses Mach. Tool Co., Cincin., O.
Garvin Mach. Co., New York.
Gisholt Mach. Co., Madison, Wis.
Hill, Clarke & Co., Boston, Mass.
Jones & Lamson Mch. Co., Springfield, Vt.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Lodge & Shipley Mach. Tool Co., Cincinnati, O.
Massey Mach. Co., Watertown, N. Y.
Niles-Bement-Pond Co., New York.
Potter & Johnston Mach. Co., Pawtucket, R. I.
Pratt & Whitney Co., Hartford, Conn.
Springfield Mch. Tool Co., Springfield, O.
Warner & Swasey Co., Cleveland, Ohio.
Windsor Mach. Co., Windsor, Vt.

Twist Drills
Boker & Co., Hermann, New York.
Cleveland Twist Drill Co., Cleveland, O.
Hammacher, Schlemmer & Co., New York.
Morse Twist Drill & M. Co., New Bedford, Mass.
New Process Twist Drill Co., Taunton, Mass.
Niles-Bement-Pond Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Phillips & Sons Co., F. R., Philadelphia, Pa.
Royal Metal Steel Co., New York.
Standard Tool Co., Cleveland, O.
Whitman & Barnes Mfg. Co., Chicago, Ill.

Universal Joints
Baush Mach. Tool Co., Springfield, Mass.
Boston Gear Wks., Boston, Mass.
Gould & Eberhardt, Newark, N. J.
Gray & Prior Mach. Co., Hartford, Conn.
Mutual Machine Co., Hartford, Conn.

Unions, Brass
Lunkenheimer Co., Cincinnati, O.
Nolte Brass Co., Springfield, O.

Valves
See Steam Specialties.

Vises, Drill
Hopkinson Mach. Works, Springfield, Mass.

Vises, Metal Workers'
Athol Machine Co., Athol, Mass.
Emmert Mfg. Co., Waynesboro, Pa.
Hammacher, Schlemmer & Co., New York.
Merrill Bros., Brooklyn, N. Y.
Parker Co., Chas., Meriden, Conn.
Reed Mfg. Co., Erie, Pa.

Vises, Pipe
Curtis & Curtis Co., Bridgeport, Conn.
Saunders' Sons, D., Yonkers, N. Y.

Vises, Planer and Shaper
American Tool Wks. Co., Cin., O.
Cincinnati Planer Co., Cincin., O.
Hendey Mach. Co., Torrington, Conn.
Niles-Bement-Pond Co., New York.

Vises, Universal Machine
Graham Mfg. Co., Provi., R. I.

Vises, Wood Workers'
Emmert Mfg. Co., Waynesboro, Pa.
Hammacher, Schlemmer & Co., New York.
Parker Co., Chas., Meriden, Conn.
Wyman & Gordon, Worcester, Mass.

Watchmen's Clocks
Simplex Time Recorder Co., Gardner, Mass.

Welding
Goldschmidt Thermit Co., New York.

Welding, Electric
American Tube & Stamping Co., Bridgeport, Conn.
C & C Elec. Co., New York.
Standard Welding Co., Cleveland, Ohio.

Welding Machines
Long & Allstatter Co., Hamilton, Ohio.

Welding Plates
Phillips & Sons Co., F. R., Philadelphia, Pa.

Wire-Drawing Machinery
Iroquois Mach. Co., New York.
Waterbury Farrel Fdry. & Mach. Co., Waterbury, Conn.

Wire-Straightening Machinery
Hoefer Mfg. Co., Freeport, Ill.

Wood Working Machinery
Pryibil, P., New York.
Seneca Falls Mfg. Co., Seneca Falls, N. Y.

Worm Hobbing Machines
Pratt & Whitney Co., Hartford, Conn.

Worm Milling Machines
Cleveland Automatic Mach. Co., Cleveland, O.
Pratt & Whitney Co., Hartford, Conn.

Wrenches, Drop Forged
Billings & Spencer Co., Hartford, Conn.
Williams & Co., J. H., Brooklyn, N. Y.

Wrenches, Machinists'
Athol Machine Co., Athol, Mass.
Bemis & Call Hardware & Tool Co., Springfield, Mass.
Billings & Spencer Co., Hartford, Conn.
Cces Wrench Co., Worcester, Mass.
Hammacher, Schlemmer & Co., New York.
Whitman & Barnes Mfg. Co., Chicago, Ill.

Wrenches, Pipe
Bemis & Call Hardware & Tool Co., Springfield, Mass.
Bullard Automatic Wrench Co., Providence, R. I.

New Grinding Machines and Attachments.

CRANKSHAFT GRINDING MACHINE.

We illustrate herewith some new grinding-machine developments from the works of the Landis Tool Company.

Fig. 1 shows a crankshaft grinding machine for the crankshaft of automobiles, launches, etc. It has a capacity up to 6-inch throws for multiple and 12-inch throws for single cranks. Both heads of the machine are live heads, being driven from the splined shaft shown in Fig. 1. When grinding the journals, the work is supported on centers, as shown in Fig. 4; but when grinding the crank-pins, centers are not used, offset heads with clamps for grasping the work by the journals being provided. One of these heads is shown in Figs. 2 and 3. The slide *a*, Fig. 3, is provided with a graduated scale at *b*, and by means of a screw *c* the head is adjusted to the desired throw of the crank. A supplementary slide *d* carries a counterweight for balancing the weight of the shaft, the counterweight being adjusted partly by this slide and partly by adding or removing sections. One-half *e* of the clamps for the journal is cast integral with the main slide, while the other half is fulcrumed at *f*. Steel bushes are used to suit the size of the work being ground.

Steady-rests for the surface being ground, together with others in line with it, are provided. They are shown applied to the work in Fig. 4 and in elevation in Fig. 5. Both of these illustrations show also the special emery-wheel truing device, which is mounted on the top of the steady-rest and may be used without removing the work from the machine. For this class of work it is essential that the ends of the journals and pins be finished with a fillet, and the truing device is arranged to give the desired radius of the fillet to the wheel, and hence to the work. The diamond swivels around the center line *a b*, Fig. 5, and is adjustable for the required radius by the knurled head *C*. When truing the wheel for the fillets the diamond is swung about the center line *a b* by the handle *d*, and when truing the edge of the wheel a pin *e* holds it from swinging. The range of adjustment for radius of fillet is up to ½ inch.

In addition to the usual graduated hand cross feed, an automatic feed is provided, which operates at each reversal of the wheel carriage. This automatic feed is adjustable to give a reduction to the work of from .00025 to .002 inch at each pass, the feed stopping automatically when the size to which it is set is reached.

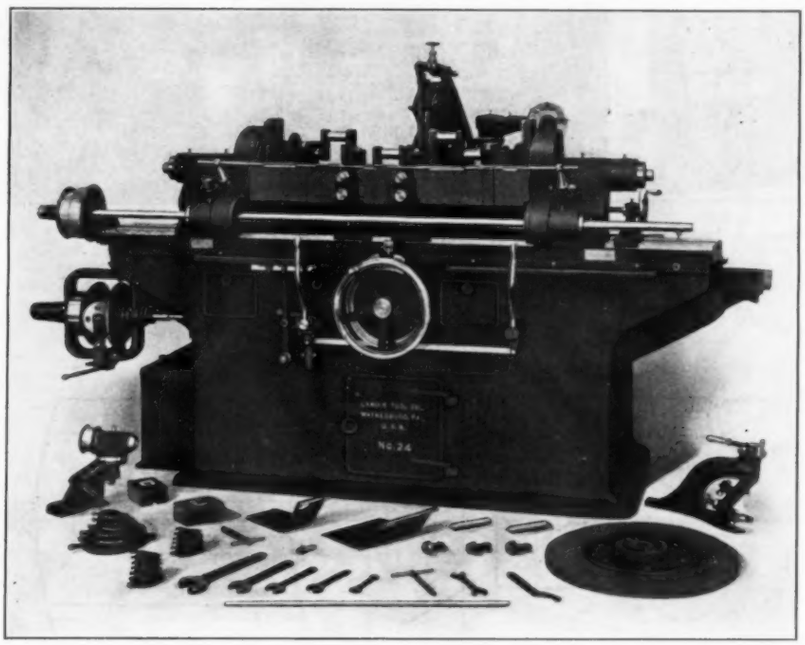


FIG. 1. CRANKSHAFT GRINDING MACHINE.

The machine is provided with twelve work speeds and an indefinite number of transverse speeds through the use of the well-known speed-changing device, shown at the left of Fig. 1. Fig. 6 shows a sample of the work done on the machine. The parts ground are four wrists, 1½ inches diameter by 3 inches long, and three journals, 1¾ inches diameter by 3, 4 and 6 inches long, respectively, the time consumed by the job being 1¼ hours.

GAP GRINDING MACHINE.

Fig. 7 shows a gap grinding machine for finishing crankshafts, piston and valve rods, with cranks, pistons and yokes in place, as well as other similar parts having projections which require a large swing while the part to be finished is relatively small. In the machine shown the gap is near the headstock, but it can be located elsewhere to accommodate center crankshafts and other similar pieces. The emery wheel head is of special design, with an offset to permit grinding close to pistons and shoulders. The radial emery wheel truing device may be applied to this machine when it is desired to grind fillets.

INTERNAL GRINDING MACHINE.

Fig. 8 shows a special machine for internal grinding only, and intended for such parts as the holes of milling cutters, shell reamers, bushings, gages, dies, etc. The position of the usual grinding head is here occupied by an intermediate driving shaft, one end of which is belted to the overhead works and the other to the emery wheel spindle. Angles are obtained as usual in grinding machines by swiveling either the table or the headstock, as shown in Fig. 9. The former has a screw adjustment and a graduated arc reading in both degrees and inches per foot. A pin at the end of the table disconnects the screw when it is desired to swing the table beyond the limits of the screw. The diamond tool-holder is clamped to the front of the table, as shown in Fig. 8, where it is always in position for use, and it need not be removed while grinding. The automatic cross-feed has the same features as the crank grinding machine.

NEW GRINDING MACHINE ATTACHMENTS.

Fig. 10 shows a new attachment for grinding concave and convex milling cutters. The emery wheel is carried by the regular side-mill grinding fixture, which is mounted on the rear of the main grinding wheel base and swung around into the position shown. The design includes two slides, at right angles with each other, which are provided with graduated scales for locating the center of the arc to which the teeth are to be ground. The tooth rest may be used from above or below, for right- or left-hand cutters. The surface of the slide to which the rest arm is bolted is so located that the rest point may be made to lie in the horizontal center line of the work spindle—a matter of importance when grinding concave cutters. The work head swivels on a pivot and has adjustable stops in the groove of its base to limit the arc of movement.

Fig. 11 shows a magnetic chuck which is screwed on the regular headstock spindle, taking the place of the face-plate. It is driven by a pulley behind it and not shown in the illustration. It is intended for grinding the sides of such parts as saws, milling cutters, washers, etc. The centering of cutters and similar pieces is by a plug fitted to enter the central hole.

Fig. 12 shows an attachment for grinding shear blades, planer and paper knives, square bars, etc. It consists of a tilting table of which the support is graduated through an arc of 90 degrees. A special grinding head for a ring wheel is used.

The Best Economy of the Piston Steam Engine at the Advent of the Steam Turbine.*

BY PROFESSOR J. E. DENTON.

When James Watt retired from business, at the beginning of the nineteenth century, he had declared his belief, based on theoretical calculations, that the water consumption of a steam engine, per horse-power, decreased with the increase of the ratio of expansion until the pressure of release should be equal to the exhaust pressure. But, although Watt invented a valve gear with which to test his theory, he never worked steam expansively to any practical degree in any of the engines built by him, because the demand for them simply as multipliers of the power available from other prime movers of that day was at too great a premium to make it necessary for the firm of Boulton & Watt to improve the economy of their engine by the application of the principle of expansion.

As builders of steam engines multiplied, however, economy became the ruling factor of competition, and the principle of expansion was applied in the pumping engines of Cornwall, with increasing economy, up to the greatest ratio of expansion consistent with commercial limits of size of cylinder per horse-power. Hence, when in 1840 one of the leading Cornish pumps was reliably tested for water consumption at ratios of expansion varying from 1.5 to 3.5, with results showing from 24 to 16.5 pounds of steam per horse-power-hour, and it was found that these figures

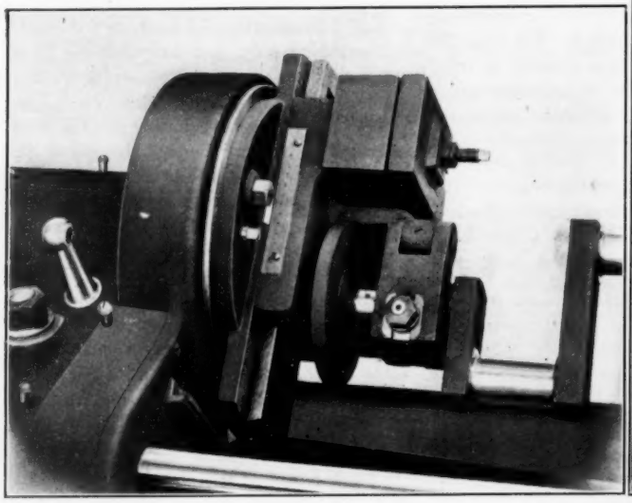


FIG. 2. OFFSET HEAD FOR CRANKSHAFTS.

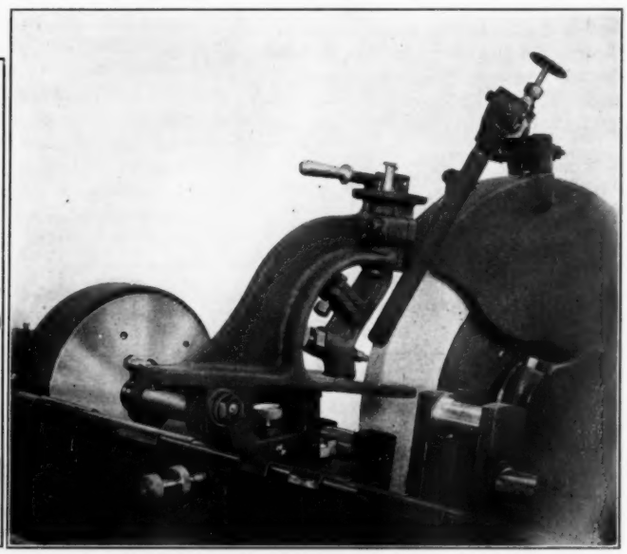
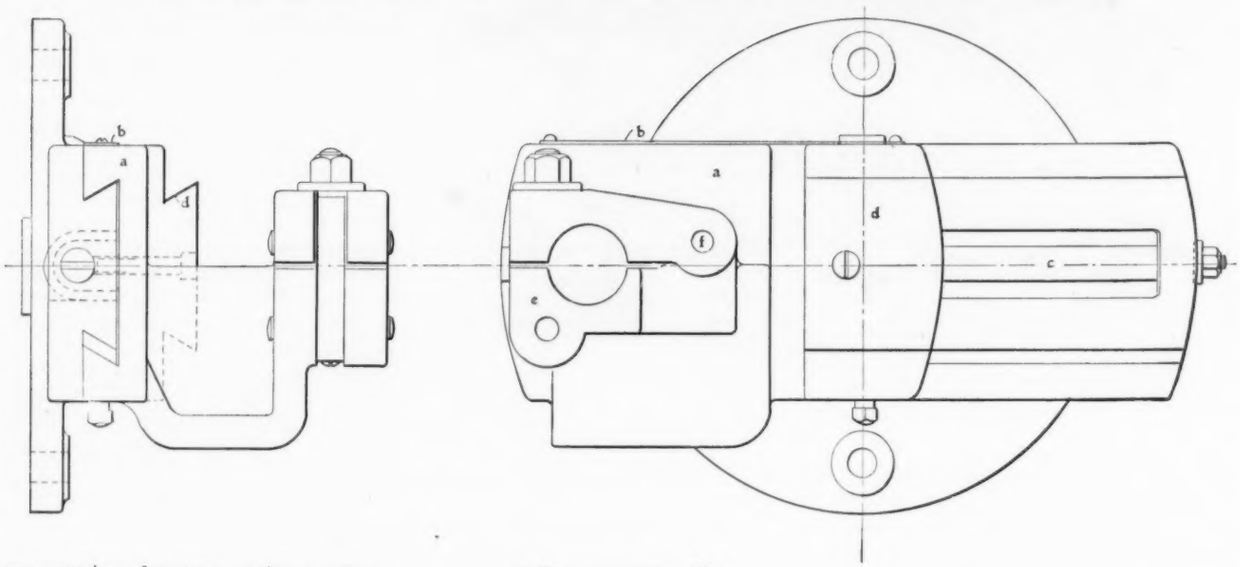


FIG. 4. EMERY-WHEEL TRUING DEVICE.



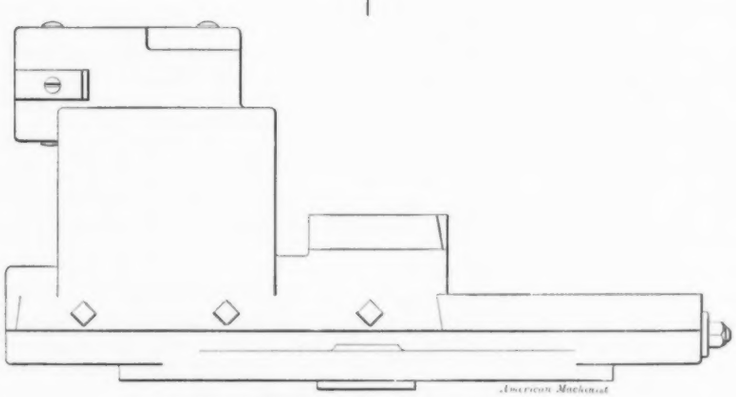


FIG. 3. OFFSET HEAD FOR CRANKSHAFTS.

*A paper presented before the Mechanical section of the International Congress of Arts and Sciences at St. Louis, September 23, 1904.

agreed with Watt's theory, belief in the latter was practically universal, and expansion was relied upon to yield similar results, in all important engines of land and sea, up to 1855.

The engineers of this time failed to realize, however, that the Cornish pump, with its single action and equilibrium exhaust, never exposed the working end of its cylinder to the temperature of the condenser, so that the range of temperature to which the admission end of the cylinder was exposed was only a fraction of that undergone by the steam, a fact which realized the conditions of action of a compound engine. They also failed to realize that the steam was superheated during admission by excessive wiredrawing from the boiler pressure of 45 pounds to 18 pounds absolute; and further, that a live-steam jacket heated the cylinder walls to initial temperature during a very slow indoor stroke, while admission occurred during the very quick outdoor stroke.

These facts made it possible for the Cornish pump to act without cylinder condensation—a phenomenon which Watt's theory did not recognize to exist; so that it was consistent that his theory should completely account for the performance of this engine as determined by experiment. But the ordinary double-acting non-jacketed engines of the marine and stationary practice of that day did not realize these passive cylinder-wall actions of the Cornish pump. Consequently, it became gradually evident toward 1860 that the steam engines of the world were failing to realize the results due to Watt's theory. This conclusion was deduced from service records of coal-consumption tests, as from 1840 to 1860 no impressive water-consumption tests were made.

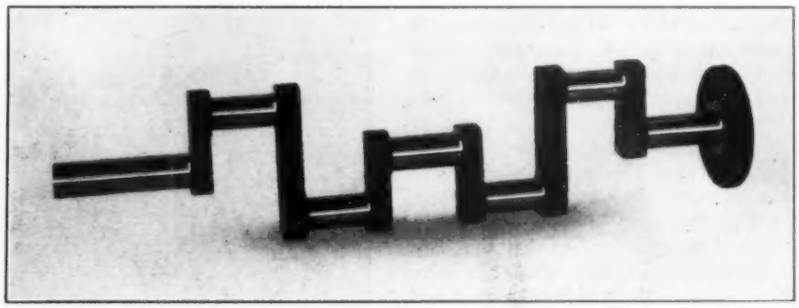


FIG. 6. SAMPLE OF WORK.

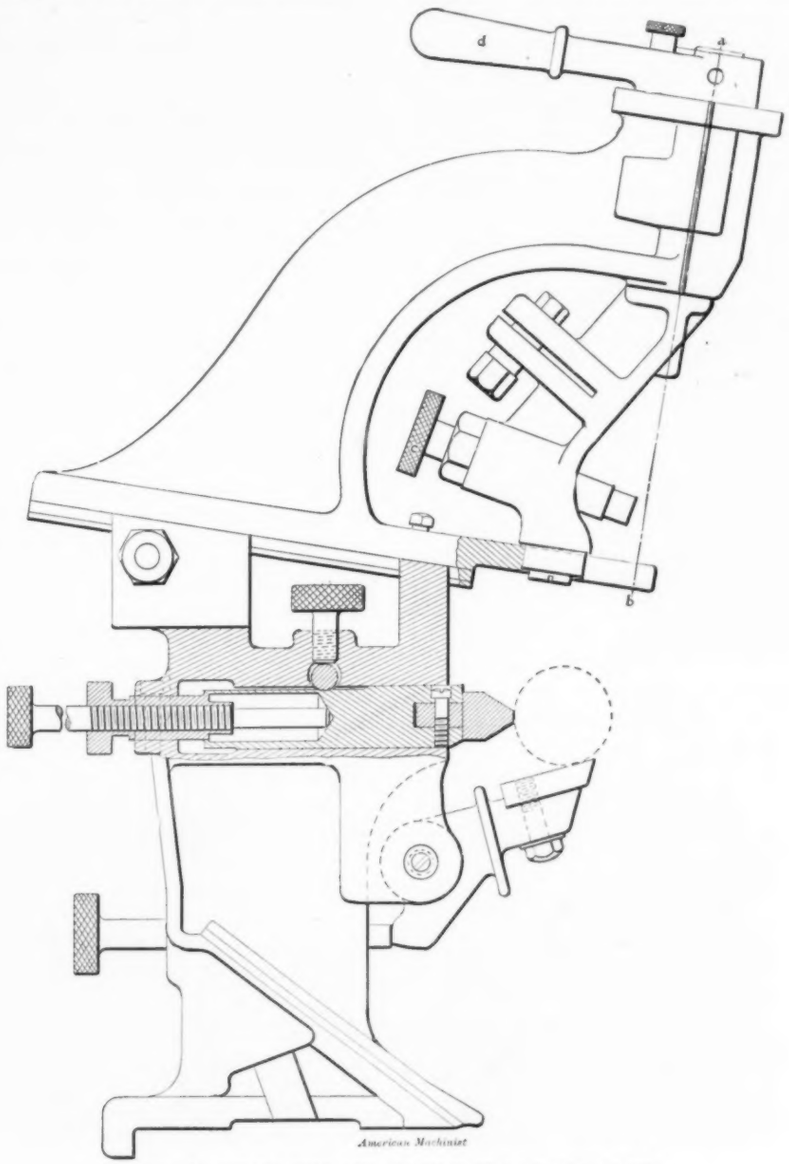


FIG. 5. STEADY REST AND EMERY-WHEEL TRUING DEVICE.

At the latter date, however, Isherwood's elaborate and thorough tests on the United States steamer "Michigan" appeared, showing a limit to the gain in steam economy by increasing ratios of expansion through the existence of some action of the steam unknown in its character but evidently not taken account of by Watt's simple theory of expansion.

Rankine's sagacious analysis of the Michigan data located this missing factor of the theory in the powerful waste action of the cylinder walls, constituting, with all of its complicated dependence on range of temperature, cylinder surface, speed and jacket influence, what we now term the "loss due to cylinder condensation." It was then quickly recognized that to realize the gain due to Watt's theory of expansion, the percentage of loss due to cylinder condensation must be confined within certain limits as the ratio of expansion increased, and that it could be by controlling its main factor (the range of temperature in the cylinder during expansion), through the division of this expansion among successive cylinders.

DEVELOPMENT OF MARINE ECONOMY.

The idea of the subdivision of the range of temperature was first extensively applied in marine practice to compound the simple condensing engine using steam at 60 to 80 pounds boiler pressure with 6 expansions, without either increasing the boiler pressure or expansion ratio. No practical gain in economy resulted from this change, as, while the range of temperature of the cylinder was cut in two and the cylinder condensation loss thereby reduced, the gain accruing therefrom was neutralized by the multilation of card area, due to the discontinuity of the expansion curve and the loss of pressure between cylinders. The water consumption, there-

fore, remained at about 19.5 pounds per horse-power, which had been afforded by the simple engine.

But the marine boiler-making art had now advanced so as to make 150 pounds steam pressure available. Therefore, the engine was able to use 14 expansions and secure such an increase in mean effective pressure as would enable a three-cylinder engine to weigh practically no more per horse-power than did that of the compound system. The marine world, therefore, sought the increased economy due to Watt's theory from 14 expansions divided among three cylinders, so that the range of temperature in each cylinder was the same as that in the compound system with lower boiler pressure. The cylinder-condensation loss was thereby controlled, so that the gain in economy due to the greater ratio of expansion under Watt's law preponderated over the loss due to broken card area. The result was, taking the merchant marine engines as the standard of economy, that the water consumption fell to 15 pounds per horse-power. The triple-expansion engine at sea, therefore, afforded the first real gain in economy over the simple engine of 6 expansions, which was prevalent when the phenomenon of cylinder condensation was discovered.

Further development of marine-boiler construction now supplies the merchant marine with 210 pounds of pressure from Scotch fire-tube boilers. This permits the use of 15 expansions with 39 pounds of total mean effective power, or about 30 per cent. increase over that of the 150 pounds triple-expansion engine; this, together with increased revolution by virtue of improvements in lubrication and construction of bearings supplemented by more perfect balancing of moving parts and no greater mutilation of card area than in the triple engine, permits the use of four-stage expansion engines whose weight is within satisfactory commercial limits.

With the expansion divided into four stages, in four or more cylinders, the temperature range per cylinder is reduced over that of the triple engine, with a resulting reduction of cylinder-condensation loss, so as to afford a water consumption of 13.6 pounds per horse-power-hour of the main engine, with a vacuum of 25.5 inches. This economy is attained with saturated steam without jackets or reheaters, the latter never having shown sufficient gain on marine engines to compensate for the care necessary to manage them; and it applies to all engines above 5,000 horse-power, the gain in economy due to larger size being indistinguishable by service records.

With an attached air pump, the usual auxiliaries consume steam which increases the water consumption to 14.4 pounds per horse-power of the main engine. The exhaust of these auxiliaries applied to heating the feed water, supplies it to the boilers at fully 200 degrees Fahr. From this temperature Scotch boilers with Howden's system of draft, burning about 21 pounds of the best semi-bituminous coal

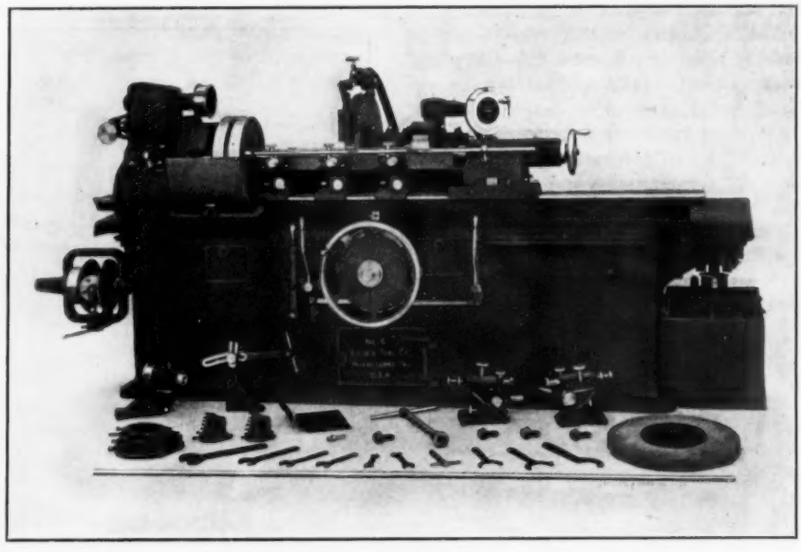


FIG. 7. GAP GRINDING MACHINE.

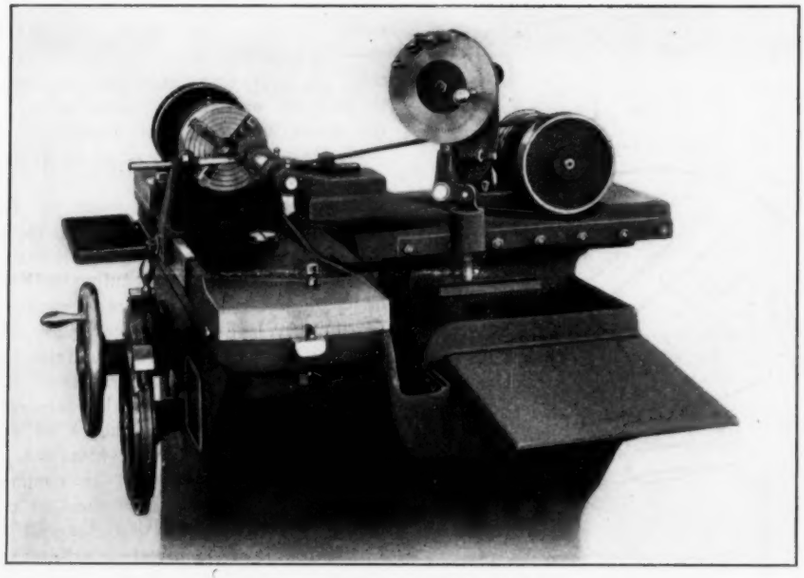


FIG. 8. INTERNAL GRINDING MACHINE.

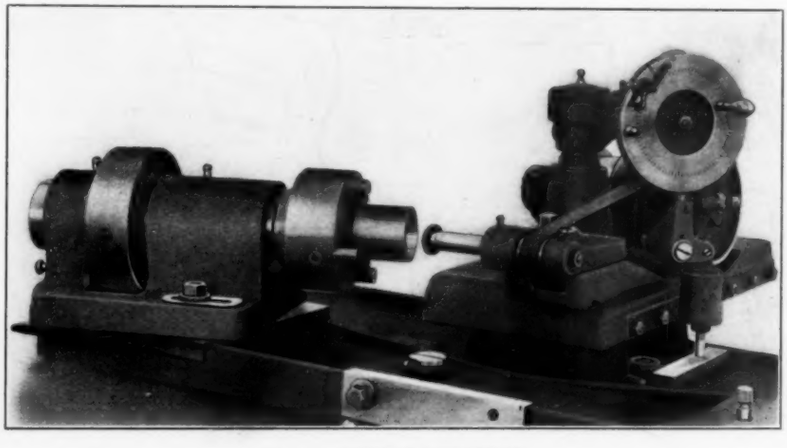


FIG. 9. SWIVELED HEADSTOCK.

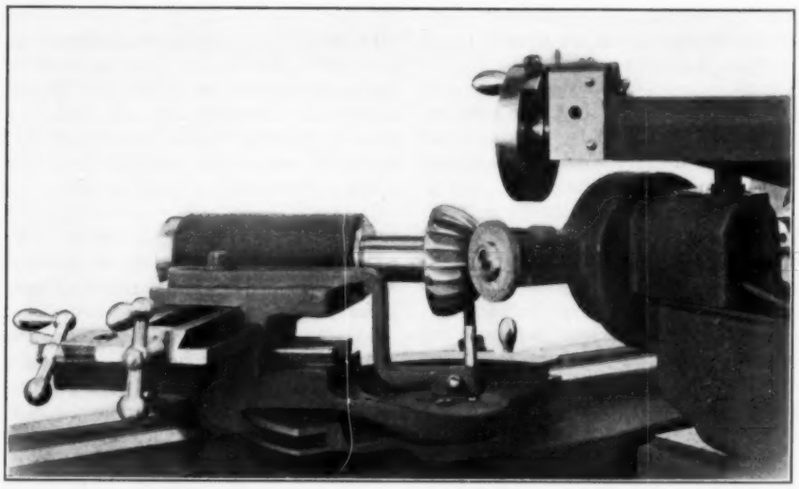


FIG. 10. CONCAVE AND CONVEX CUTTER-GRINDING ATTACHMENT.

per square foot of grate per hour, evaporate 11 pounds of actual feed water per pound of coal. Thus for each indicated horse-power of the main engine 1.3 pounds of coal are consumed per hour.

Without an increase in boiler pressure above 210 pounds, further increase in economy can only be obtained with higher ratios of expansion, and this is prohibited because the consequent reduction of mean effective pressure would increase the weight of the engine per horse-power beyond commercially acceptable limits.

With higher boiler pressure greater economy can be obtained from the engine by increasing the expansion up to probably a ratio of 30, but to accomplish this without increase of weight of engine per horse-power would require a working pressure of steam of 300 pounds per square inch. This must be obtained from water-tube boilers, as the Scotch boiler is now at the limit of practicable construction and allowable weight when built for 210 pounds steam pressure.

Higher economy of engine is obtainable, with present pressures and ratios of expansion, by the use of superheated steam.

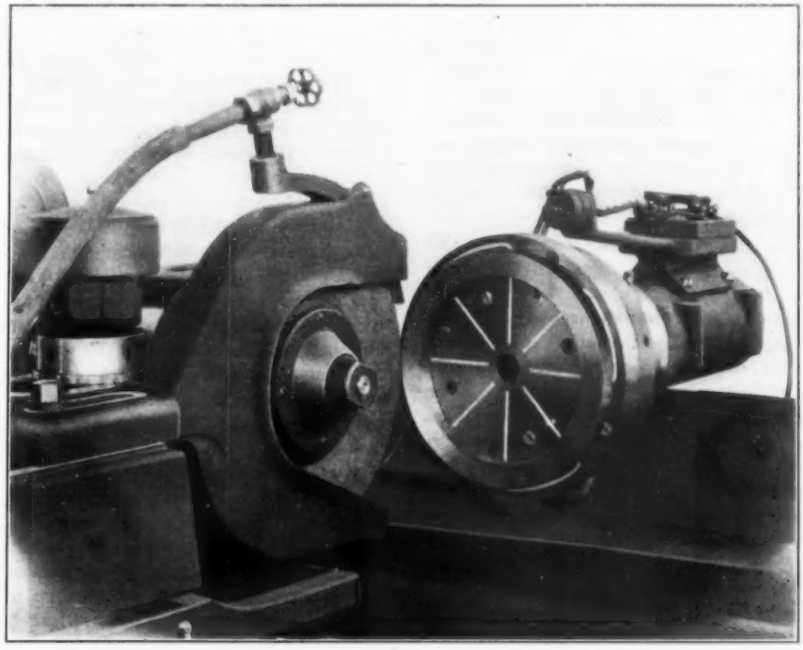


FIG. 11. MAGNETIC CHUCK.

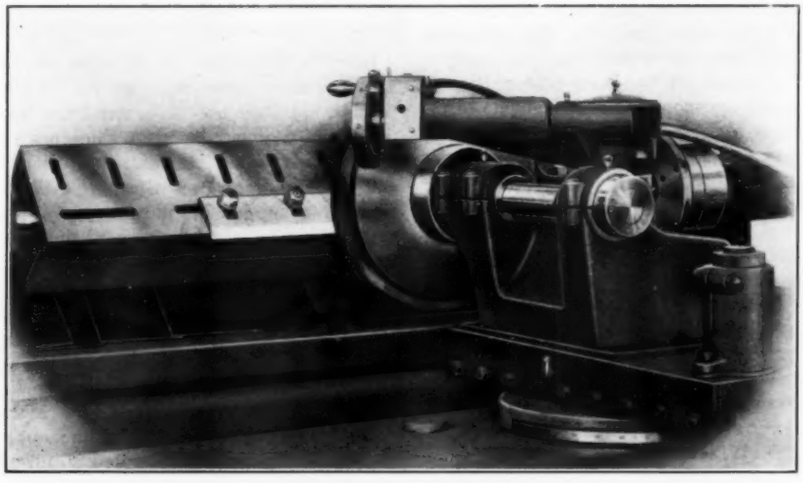


FIG. 12. PLAIN SURFACE GRINDING ATTACHMENT.

but the application of the latter has not thus far shown a gain in coal economy in transatlantic marine practice. This is doubtless ascribable to the use of imperfectly designed superheaters; but the increase of cylinder oil which superheating requires makes its successful introduction at sea questionable, on account of the difficulty of protecting the boilers against over-fouling by accumulation of oily deposit.

At the advent of the steam turbine in marine practice, therefore, the degree of economy with which it must compete in marine engines on the largest scale is that of a quadruple-expansion system expanding saturated steam with 210 pounds pressure, fifteen times, into a vacuum of 25.5 inches with an economy of 13.6 pounds of water per horse-power-hour of the main engine; which will operate, with its auxiliaries, from Scotch boilers on the Howden system, with a consumption of 1.3 pounds of the best semi-bituminous coal per indicated horse-power-hour of the main engine.

If the turbine could operate screw propellers efficiently with the same rotational speeds for a given horse-power that it uses in electric service, the record for economy already established by the turbine shows its ability to easily compete with these conditions of performance of the best marine engine. But such rotational speeds for the turbine are inconsistent with the degree of screw-propeller efficiency available from piston engines.

Therefore the possibilities as regards steam economy of the turbine in marine practice are as yet too unsettled to permit of their definite statement within the limits of this paper.

DEVELOPMENT OF STATIONARY-ENGINE ECONOMY.

Stationary engines at the date of the discovery of cylinder condensation were affording the maximum economy in simple condensing cylinders expanding steam of from 60 to 80 pounds pressure six times, with a vacuum of about 27 inches, which afforded a water consumption of about 19 pounds per horse-power-hour.

The first noteworthy improvement upon this degree of economy was obtained in the Leavitt pump at Lawrence, Mass., which, by expanding 120 pounds steam sixteen times in two cylinders, secured a water consumption of 16.5 pounds per horse-power. This, however, was a compound engine without a receiver, or what is known as the "Wolff" system, which does not divide the range of temperature due to expansion between the two cylinders, as the high cylinder is in connection with the low during the whole of the latter's expansion period. This fact and the slow speed of 12 revolutions per minute made the initial cylinder condensation 40 per cent., or nearly twice that of the six-expansion simple condensing engines; besides which, live-steam jackets on both cylinders consumed 10 per cent. of the total steam.

The gain in economy over the simple engine was therefore due entirely to the influence of the high ratio of expansion, aided by high initial pressure and so strong a re-evaporative effect that the expansion line was outside of a Mariotte curve to the end of the expansion. The combined effect of these more than offset the negative influence of the high percentage of cylinder condensation. The engine was, however, the most economical of its time (1872), and it is interesting to note that its conditions of steam action were widely in contrast with that of the most economical Cornish pumping engine of 1840, which afforded precisely the same water consumption of 16.5 pounds by expanding 30 pounds steam three and one-half times, with a complete avoidance of loss by cylinder condensation.

The first prominent advance in economy by division of the range of temperature was obtained about 1878 in the Corliss Pawtucket compound pumping engine. This also expanded 120 pounds steam sixteen times in two cylinders, but with a receiver between them; whereby, with the aid of a speed of 50 revolutions and only 5 per cent. jacket consumption, the cylinder-condensation loss was reduced to 25 per cent., and a water consumption of only 13.7 pounds resulted. This result led Corliss to introduce similar compound engines into mill practice, and they were then rapidly substituted throughout the world in all large power-using industries for the single 6-expansion condensing engine. All makers of 4-valve drop cut-off engines in both the United States and Europe obtained from them a water consumption of from 13.5 to 14 pounds per horse-power with about 125 pounds steam pressure and about 16 expansions.

The gain from one division of temperature being thus established, triple-expansion engines were quickly introduced for mill and electric service by Corliss and Allis in the United States and Sulzer in Germany, to obtain a further gain from two divisions of temperature. None of the triple-expansion engines succeeded, however, in reducing the water consumption below 12.5 pounds per horse-power, which was not a sufficient gain over the compound engine to offset the extra cost and care of the third-expansion stage. Its use was therefore quickly abandoned in mill and electric-light service in favor of the compound engine.

Such a general readoption of the compound type resulted in a variety of cylinder ratios being used as involving possibilities of improved economy over the ratio of 4 to 1 introduced by Corliss. The first radical departure appeared in the Rockwood & Greene system, which was introduced into New England with a cylinder ratio of about 7 to 1, and clearances of about 2 per cent., instead of the 4 per cent. value previously prevailing. With 150 pounds steam pressure, live-steam jackets on either the heads or barrels of both cylinders, and a live-steam reheating receiver, such engines have afforded 12.45 pounds per horse-power with saturated steam expanded twenty-six times into about 27.5 inches of vacuum. Without the jackets and reheater in use, about 2 per cent. greater water consumption is obtained. The jackets and reheater, when in use, consume only about 8 per cent. of the total steam, with practically 25 per cent. of cylinder condensation under both conditions.

The performance represents the best economy derived from the compound engine for mill and electric practice up to within a few years ago, and it has largely established the belief that a cylinder ratio of about 7 to 1, with so small a clearance as 2 per cent., is necessary to maximum compound-engine economy. During the last two years, however, the following records have been established:

(1) With an 850-horse-power Rice & Sargent compound Corliss engine, running at 120 revolutions per minute, having a 4 to 1 cylinder ratio, clearances of 4 per cent. and 7 per cent., live jackets on cylinder heads and live steam in reheater, Professor Jacobus, of Hoboken, found for 600 horse-power of load, with 150 pounds pressure of saturated steam, 28.6 inches of vacuum, and 33 expansions, 12.1 pounds of water consumption per horse-power—a result produced with a cylinder-condensation loss of 22 per cent., and a jacket consumption of 10.7 per cent. of the total steam consumption.

(2) With a 250 horse-power Belgian Van den Kerchove poppet-valve compound engine, running at 126 revolutions per minute, with 2.97 to 1 cylinder ratio, clearances of 4 per cent., steam-chest jackets on barrels and head, and no reheater, Professor Schröter, of Munich, found 117 horse-power of load, 130 pounds pressure of saturated steam, 27.6 inches of vacuum, and 32 expansions, 11.98 pounds of water per horse-power—a result produced with a cylinder-condensation loss of 23.5 per cent., and a jacket consumption of 7 per cent. of the total steam consumption in the high cylinder jacket and 7 per cent. in the low jacket.

(3) With the Westinghouse twin low-cylinder, compound combined poppet-valve and Corliss-valve engine, at the New York Edison plant, running 76 revolutions, with 5.8 to 1 cylinder ratio, clearances of 10.5 per cent. and 4 per cent., without jackets or reheater, Messrs. Andrew, Witham and Wells found for the full load of 5,400 horse-power, 185 pounds steam pressure, 27.3 inches of vacuum, and 29 expansions, 11.93 pounds of water per indicated horse-power, a result produced with an initial condensation of about 32 per cent.

These facts show that the minimum water consumption of the compound mill engine and electric-light engine of the present date, using saturated steam, is not dependent upon any particular cylinder ratio and clearance nor upon any system of jacketing, but that the essential condition is the use of a ratio of expansion of about 30, above which the cylinder-condensation loss is liable to prevail over the influence of the law of expansion. The conclusion appears warranted, therefore, that if this ratio of expansion is secured with any of the current cylinder and clearance ratios, and with any existing system of jackets and reheaters, or without them, a water consumption of 12.4 pounds per horse-power is possible, and that a variation of fourtenths of a pound below or above this figure may occur by the accidental favorable, or unfavorable, jacket and cylinder-wall expenses which are beyond the exact control of the designer.

COMPOUND PISTON ENGINE ECONOMY VS. HEAT OF STEAM TURBINE.

In order to compare the economy of the piston engine with that of the steam turbine, we must use the water consumption per brake horse-power, since no indicator card is possible from the turbine; and furthermore, we must use the average water consumption for the range of loads to which engines are subject in practice.

In all of the public turbine tests to date, with one exception the output was measured through the electric power of a dynamo whose efficiency is not given for the range of loading employed, so that the average brake horse-power is not known. This exception is the Dean and Main test of a 600 horse-power Westinghouse-Parsons turbine using saturated steam at 150 pounds pressure, and a 28-inch vacuum. We may compare the results of this test

with that of the 850 horse-power Rice & Sargent engine, and the 250 horse-power Belgian engine, by assuming that the power absorbed by friction in these engines is 3 per cent. of the indicated load plus the power shown by friction cards taken with the engine unloaded. The latter showed 5 per cent. of the rated power in the case of the Rice engine and 8 per cent. in the Belgian engine; so that the assumption regarding the load friction is a reasonable one.

The results are given in the following table, which shows the average water consumption per horse-power, for from 40 per cent. to 125 of full load, to be 14.55 pounds and 14.64 pounds for the two piston engines, and 14.51 pounds for the turbine, or practical equality:

Per Cent. of Full Load.	Lbs. Water per Brake H.-P. Hour.		
	600 H.-P. Turbine.	850 H.-P. Rice Engine.	250 H.-P. Belgian Engine.
125	13.62	13.78	15.10
100	13.91	13.44	14.15
75	14.48	13.66	13.99
41	16.05	17.36	15.31
Average 85	14.51	14.56	14.64

AVERAGE STEAM CONSUMPTION PER BRAKE HORSE-POWER OF PISTON ENGINE VS. TURBINE.

As an indication of the gain in economy of the turbine with increase of size, we may use the Elberfeld test of a Parsons turbine at the full load of 1,500 electric horse-power, with an allowance of 5 per cent. for attached air pump, and an assumed minimum generator efficiency of 0.95. Its saturated steam consumption, with 150 pounds boiler pressure and 28 inches of vacuum, is then 13.08 pounds per brake horse-power-hour, which shows a gain of 4 per cent. over the 600-horse-power machine.

The 5,400 horse-power Westinghouse compound engine at the New York Edison station, whose friction under full load was cleverly determined at about 4 per cent., affords a brake horse-power consumption of 12.5 pounds for 185 pounds boiler pressure. Crediting the turbine, therefore, with the possible influence of the difference in size and steam pressure, there is again practical equality in economy between it and the piston engine for equal horse-power.

DEVELOPMENT OF PUMPING-ENGINE ECONOMY.

While the mill and electric practice has developed the compound engine, pumping engines in the United States have been developed in the triple-expansion flywheel type to a degree of economy superior to that afforded by any compound mill or electric engine, and, for saturated steam, superior to that of the pumping engines of any other country. This is because their slow speed permits of greater benefit from jackets and reheaters and of less losses from wiredrawing and back pressure. These causes, together with the greater subdivision of the range of cylinder, have resulted in records made between 1894 and 1900 of 11.22, 11.26 and 11.05 pounds of saturated steam per indicated horse-power, with 175 pounds steam pressure and from 25 to 33 expansions, in the cases of the Leavitt, Snow and Allis pumping engines, respectively, the corresponding heat consumption being by different dispositions of the jacket drainage, 204, 208 and 212 thermal units per indicated horse-power-minute; while later the Allis pump, with 85 pounds steam pressure, has lowered the record to 10.33 pounds of saturated steam per indicated horse-power, with 196 heat units of consumption per horse-power-minute.

The turbine can compete with these pumping engines only through the medium of a multiple-stage centrifugal pump, whose efficiency, taken even at 80 per cent., will probably impose too great a loss of motive power on the turbine system for successful competition with this high class of piston pump, since the friction loss of the latter is only 5 per cent. of the indicated horse-power.

GAIN FROM SUPERHEATING AND FROM THE SULPHUR-DIOXID EXHAUST-HEAT ENGINE.

For opening the way to the improvement of the piston steam engine beyond any degree represented by the results we have thus far presented, we must make our bow exclusively to the Germans. By their revival of the use of superheated steam, after it had been twice abandoned in the history of steam engineering, they have demonstrated the practical success of superheating to raise the economy of any engine, whatever its boiler pressure or ratio of expansion, by rendering the steam a more efficient working medium on its entry to the engine. By showing that after the steam has been expanded to its greatest practical limits in piston engines an important amount of power can still be practically abstracted from it in the sulphur-dioxid engine, they have also reduced the waste accompanying its exit from the engine.

Previous attempts to use superheated steam failed because of the lowered efficiency of the boiler through the location of the superheating device in the chimney. Here the superheater was so arranged that the exit temperature of the heated gases had to be in excess of the superheated steam temperature to such a degree that the boiler's economy was lowered; and also the superheating surface so located and in contact only with steam was rapidly corroded. These defects the Germans have overcome by arranging the superheater so that it receives wet steam at the chimney end of the system, and lies at the middle of the flame current at the point where the superheated steam is delivered from it to the engine. Thus the hot gases can enter the chimney at no higher temperature than is consistent with the best economy from saturated steam boilers, and experience thus far shows no impracticable rate of depreciation of the superheater from corrosion.

The difficulty of conveying highly superheated steam from the boiler to the engine without excessive loss of temperature has also been overcome by improved and thicker pipe installation and the use of about half the pipe section usually employed for saturated steam. The generator plant has therefore been perfected so that it does not handicap the value of the superheated steam to the engine, while the latter is adapted to work the steam without lubrication difficulties by the use of poppet valves on at least the initial cylinder.

The maximum of improvement in economy over saturated steam may be briefly summarized in the following extract from an admirable investigation by the most distinguished European authority on engine tests, Professor Schröter, of Munich: The engine used was the compound 250 horse-power 13 and 21 by 33 inch Belgian Van den Kerchove construction, previously mentioned, operating with a boiler pressure of 130 pounds, and 27.6 inches of vacuum, with 30.18 inches of barometer. For saturated steam the average water consumption for five divisions of load, between 40 and 125 per cent. of rated load is 12.45 pounds per English indicated horse-power-hour, with 3.6 per cent. of steam condensed in the high jacket at 130 pounds pressure, and 9 per cent. in the low jacket, including the receiver, at 5 pounds pressure. Assuming the jacket drainages applied to heat the feed water from a temperature of 108 degrees in the hot well, 136 degrees Fahr. feed temperature would be afforded. Reckoning the expense of heat from this temperature, the consumption is 225 thermal units per indicated horse-power-minute.

With steam superheated 224 degrees Fahr. above saturation, or at 304 degrees Cent., the average consumption for the same divisions of load is 10.09 pounds of feed water per horse-power. With one-third of 1 per cent. high jacket and 3 per cent. low jacket and receiver consumption, the jacket water would heat the feed water to 115 degrees Fahr. at the same hot-well temperature. Reckoning from this temperature, with a specific heat value of 0.6, according to the experiments of Lorenz and of Bach, the heat expense is 209 thermal units per horse-power-minute. The average gain by superheating 224 degrees Fahr. is therefore 7 per cent. If the feed water were heated to 200 degrees by auxiliaries, the heat unit gain would be 8 per cent.

With steam superheated 307 degrees Fahr. above saturation, or at 350 degrees Cent., and the load at about 80 per cent. of rating, the water consumption was 8.99 pounds per English horse-power, with 0.4

of 1 per cent. condensation in the high jacket and 4 per cent. in the low. This affords 114 degrees Fahr. temperature, and with a specific heat of say 0.57 (since according to Lorenz's experiments the specific heat reduces with increase of superheat at any given pressure), we have a heat consumption of 192 thermal units per horse-power-minute. The same load with saturated steam affords 137 degrees Fahr. of feed temperature and gives 221 units of heat consumption per horse-power. The gain for 307 degrees superheating over saturated steam for the same horse-power is therefore 13 per cent. from the natural feed temperature and for 200 degrees feed. 14 per cent.

The best performance reported for superheated steam used in the turbine is that of Brown & Boveri Parsons Frankfort 4,000 horse-power machine, which, with 183 pounds boiler pressure above the atmosphere and 190 degrees Fahr. superheat, afforded 10.28 pounds per brake horse-power, assuming a generator efficiency of 0.95. Reckoning from the feed temperature of its vacuum of 27.5 inches, and using a specific heat value of 0.65, the heat consumption is 214 thermal units per horse-power-minute.

The heat consumption of the 250-horse-power Belgian compound engine per brake horse-power at the highest superheating of 307 degrees Fahr. is 220 thermal units. The turbine, therefore, probably holds the record for brake horse-power economy over the piston engine for superheated steam by a margin of about 3 per cent., although had the compound engine been of the same horse-power as the turbine, so that its friction load would be only 8 per cent. of its power instead of the 13 per cent. here allowed, it would have excelled the turbine in brake horse-power economy by a margin of about 2.5 per cent.

THE SULPHUR-DIOXID ADDENDA.

The most economical piston engines, which, as we have seen, expand steam about thirty times, release their steam at the end of the stroke at about 6 pounds absolute pressure, but they exhaust into a condenser, which, with a vacuum of 28 inches, contains a pressure of about 1 pound absolute per square inch. If the expansion could continue until the pressure of 1 pound was attained before exhaust occurred, considerable more work could be obtained from the steam. This, however, cannot be done in piston engines, for two reasons: first, because the low cylinder would have to be about five times greater in volume, which is commercially impracticable; and, second, because the velocity of exit through the largest exhaust ports possible is so great that the frictional resistance of the steam makes the back pressure from 1 to 3 pounds higher than the condenser pressure in the best engines of ordinary piston speed.

All the work due to this extra expansion can be obtained, however, by exhausting the steam from the low cylinder at 6 pounds pressure, against a nest of tubes containing liquid sulphur dioxid. which thereby is boiled to a vapor of about 170 pounds pressure. This can be used to drive the piston of a separate engine or an extra cylinder attached to the main engine, and be thence exhausted into a condenser to be reliquefied. If the sulphur dioxid expands in its cylinder to a pressure corresponding to its temperature of liquefaction, and the latter is that of steam at 1 pound pressure, the work derived from the fluid is the same as the extra work which the steam would have furnished in the main cylinder by continuing to expand to 1 pound pressure and exhausting against 1 pound of constant back pressure. The greatest vacuum required in this system does not need to be more than 20 inches, which is very easily produced and maintained, as compared with a vacuum of 28 inches, corresponding to 1 pound of absolute pressure.

Professor Josse, of Berlin, has perfected this sulphur-dioxid system of improvement, and reliable tests have shown that if cooling water of 65 degrees Fahr. is available, and to the extent of about twice the quantity usually employed for condensing steam under 28 inches of vacuum, a sulphur-dioxid cylinder of about half the size of the high-pressure cylinder of a compound engine will do sufficient work to improve the best economy of such engines at least 15 per cent. The steam turbine expands its steam to the pressure of its exhaust chamber, and as unlimited escape ports can be provided from this chamber to a condenser, it follows that the turbine can practically expand its steam to the pressure of the condenser. Therefore a steam turbine attached to a piston engine to operate with the latter's exhaust should effect the same saving as the sulphur-dioxid cylinder, and turbines are being applied for this purpose at present by the makers of the Rateau type.

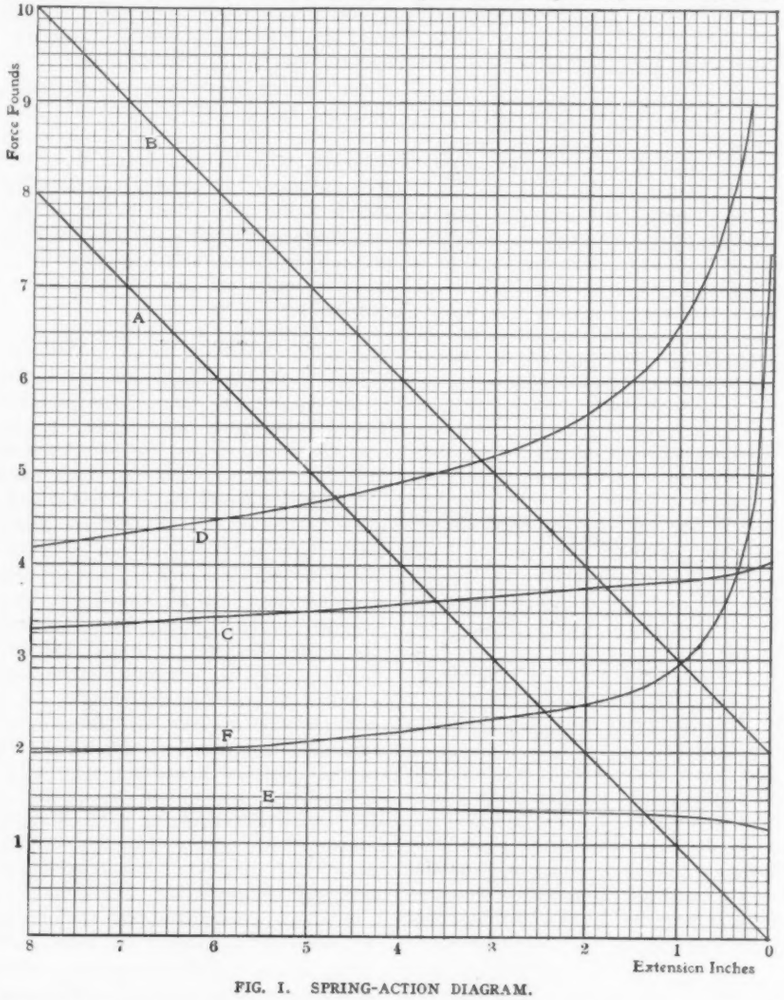


FIG. I. SPRING-ACTION DIAGRAM.

The turbine, therefore, even at this early period of its history, is already a formidable competitor to the piston steam engine in its most economical degree; and that it is so is mainly due to the fact that with no more waste in its steam action from internal friction than is due to the cylinder-wall wastes of the piston steam engine which are absent in the turbine, it more completely realizes the expansive principle enunciated in the infancy of steam history as the fundamental factor of economy, by its sagacious founder, James Watt.

The Modification of Spring Action by Toggle Joints.

BY E. H. FISH.

We often wish to counterbalance some weight or force which is constant, in a position where the addition of another weight is objectionable. It may be undesirable to add to the weight of the machine, it may be that the travel of the part to be counterbalanced is not always in the same direction, or in many ways it may happen that we cannot use weights to advantage and we would like to use springs. The use of a direct-acting spring in most cases is unsatisfactory, owing to the fact that an increase in length is followed by an increase in tension, when we require a constant tension, no matter what the increase in length.

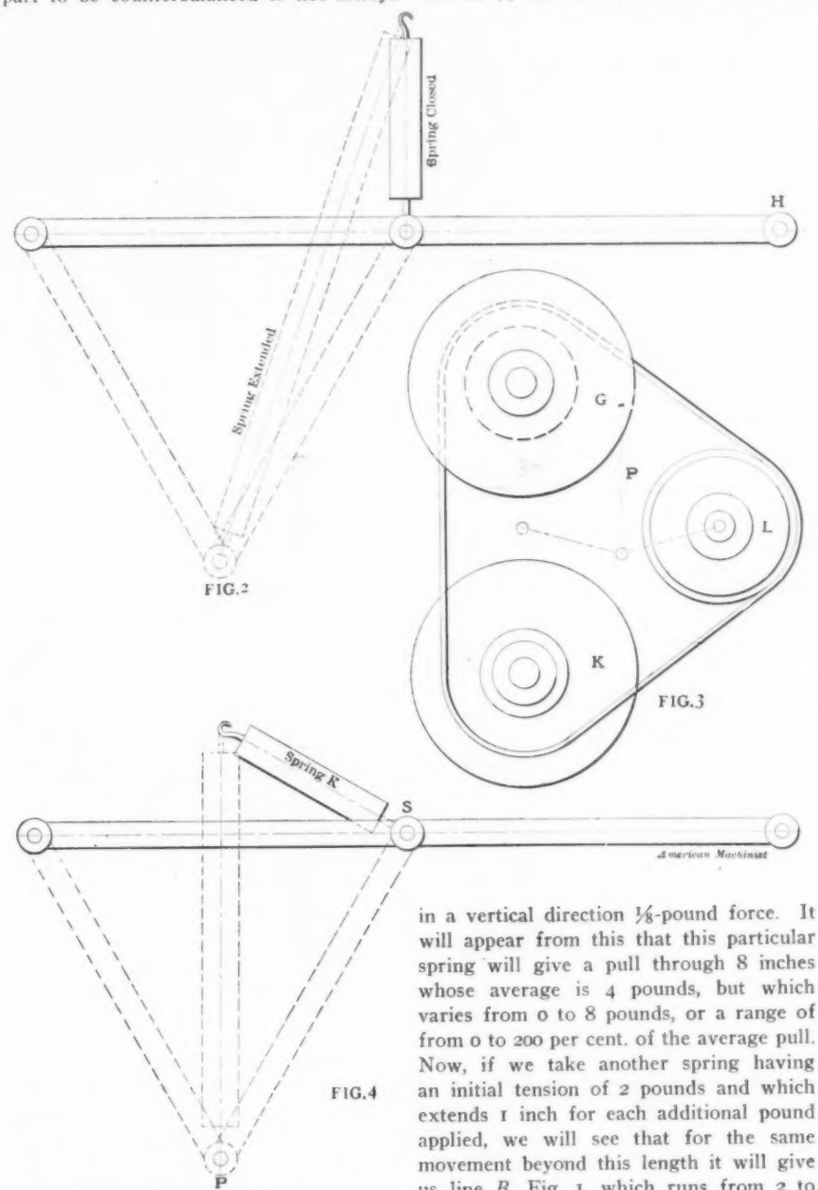


FIG. 2

FIG. 3

FIG. 4

A COMBINED SPRING AND TOGGLE JOINT MECHANISM.

Suppose we have a spring whose normal length is 4⅝ inches (the reason for using this length will appear later) of such proportions that a pull of one pound will extend it one inch. It is evident that an additional pound will extend it another inch, and so on. If we plot this as in Fig. 1, we get straight line *A*. It is supposed that our spring is pulling against some resistance from right to left, that each divison in a horizontal direction represents ⅛-inch motion and each division in a vertical direction ⅛-pound force. It will appear from this that this particular spring will give a pull through 8 inches whose average is 4 pounds, but which varies from 0 to 8 pounds, or a range of from 0 to 200 per cent. of the average pull. Now, if we take another spring having an initial tension of 2 pounds and which extends 1 inch for each additional pound applied, we will see that for the same movement beyond this length it will give us line *B*, Fig. 1, which runs from 2 to 10 pounds, of which the average is 6, running from 33⅓ per cent. to 166⅔ per cent. of the average, which is somewhat better, though the line *B* is just as steep as *A*. Here we have an extension of a 2⅝-inch spring through 10 inches, which is impracticable.

Let us now see what we can get from the first inch of *A* from the right, and the last inch of *B*. On *A* we run from 0 to 1 pound, average ½, variation in percentage of the average from 0 to 200 per cent. On *B* we run from 9 to 10 pounds average—that is, we begin with an initial tension of 9 pounds, average 9½ pounds, variation from 95 to 105 per cent. of the average; from which we conclude that by using a spring under considerable initial tension and working through comparatively small distances, we can get much more satisfactory results than with no initial tension, but there is still room for improvement.

In working up another problem I stumbled on something which appears to fit this case. Suppose that we have a toggle joint as represented in Fig. 2, with a spring attached as shown, using the same spring as in the first instance. The links of the toggle are all 8 inches center to center, and we will use only the portion of its movement shown, the closed position of the links being 60 degrees to each other and the total movement 8 inches. The force which this arrangement would exert in the direction *H* may be plotted in Fig. 1 as line *C*, where it will be seen to run from 3 5-16 to 4 pounds for a position of the toggle links from 5 degrees below the horizontal, which would be about the practical limit. This is for zero initial tension and extends the spring 7 9-16 inches at the lowest point. This combination introduces a curiosity, mechanically speaking. If any force, however small, were exerted by the spring when the links were in line with each other, the resulting force acting along *H* would be infinite, but by our supposition there is no force exerted by the spring in this position, so the force along *H* becomes zero.

If now we give the spring in Fig. 2 two pounds initial tension—that is, use a spring 2⅝ inches normal length and stretch it 2 inches to begin with—we get curve *D*, which shows a still greater tendency to rise in the opposite way from the direct spring. Since the total extension of the spring is 9 9-16 inches on a spring whose normal length is 2⅝ inches, this is hardly practicable through its whole range.

Fig. 3 shows an end view of two conical pulleys *G* and *K*. *L* is an idler carried by an arm, not shown. It was proposed that *G* and *K* should be movable lengthwise of the shafts and independently of each other, so as to bring any point of *G* opposite any point of *K*. In order to keep an even tension on the belt, it is necessary to force the idler to the right with a greater force the further it goes, which is just the opposite of the direct spring action. Putting in a toggle joint, as indicated, with a spring at *P*, gives us a fair approximation to the desired result.

Curve *C* gave an approximation to a uniform pull which was good enough to induce us to look further, which resulted in the arrangement of Fig. 4, in which the spring is hung, as shown, from a point vertically over *R* and at 30 degrees from

the horizontal through *S*. With our 8-inch toggle links this gives us a spring 4⅝ inches long, which is the same that we have used before. The resulting curve, if there is no initial tension, is shown at *E*, Fig. 1, where the variation from a straight line is not marked enough to interfere with most uses. It is noticeable that the line is low as compared with the others. That is, a spring which extends 1 inch for each pound applied gives a fairly uniform pull of about 1⅜ pounds through 8 inches distance. The greatest stretch of the spring itself is only 4 11-16 inches for this 8 inches of motion, so a spring is needed which is a great deal heavier than if applied direct. Curve *F* shows the result of using a spring with 2 pounds initial tension, showing a sharper bend than in *D*, which is not so likely to be useful.

The *Providence Journal* of October 1, commenting on our latest battleship just launched at Cramp's, says:

The launching of the battleship "Mississippi" at Philadelphia yesterday adds to our fleet a vessel that some experts believe is already obsolete. The battery carried by the new craft is very heavy for a vessel of her displacement, but she is much smaller than most of the battleships we are building, and her speed will be considerably inferior. To include her in a squadron composed of vessels like the "Connecticut," "Rhode Island," "New Jersey" and "Louisiana" would be to retard them and hinder their effective work, as Rojestvensky's slower ships diminished the total efficiency of his ill-fated fleet in the Far East. Our largest ships may be rendered inferior to those of other nations in a few short years, but that is no argument for building craft that are even slower and less powerful. The "Mississippi" seems destined for a career on stations where she can do detached duty. Her defensive powers are large, and we need not regard her as altogether useless; but in her old-fashioned dimensions and speed capacity she is out of date before she starts on her initial cruise.

During the autumn thousands of agricultural laborers arrive at the quay in Glasgow, Scotland, *en route* to the inland farms to assist in harvesting the crops. Owing to the amount of silt washed down, dredges are always at work in the Clyde. The dredges used there are of the endless chain variety. One can see the full buckets being hauled up and disappearing under a hood, but the return of the empty buckets is under cover. One of these laborers on his first arrival in Glasgow stood on the Broomielaw, open-mouthed, watching a dredge. "Come on Mike," said his friend, "ye'l miss th' train." "Hell roast th' fut Oi stur till Oi see th' lasht bucket coom oop," Mike replied.

Lathe Design and Practice—III.

BY E. H. FISH.

METHODS OF SUPPORTING WORK.

So far we have only considered work usually done on centers from bar stock or forgings. A great deal of the work now done on an arbor can be at least roughed out in a chuck. If long it can be supported by an internal or external bearing at the tail end. An example of this comes to mind in the double quill gear for a lathe back gear shown in Fig. 13. It is first gripped by a chuck and the other end roughly centered by a conical reamer in the tailstock. Then a pipe center is put on and a spot for the center rest turned at *c*. The center rest is put on and the hole at *d* bored and reamed .005 inch under size. Then the plug shown at *d* is put in place, the center rest removed and the work roughed out. Held in this way a stiff cut and heavy feed are possible. The work is then turned around, the plug center *d* is replaced by a short centered plug driven in, a center rest is put on at *g* and that end bored and turned. It is then hand reamed and put on an arbor and turned lightly all over. The work is as thoroughly supported as possible and with very little expense for special arbors or tools.

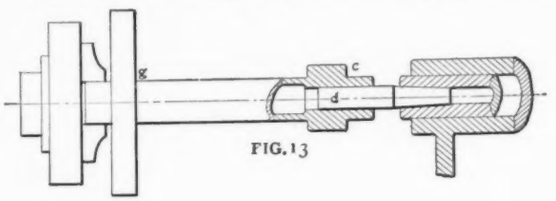


FIG. 13

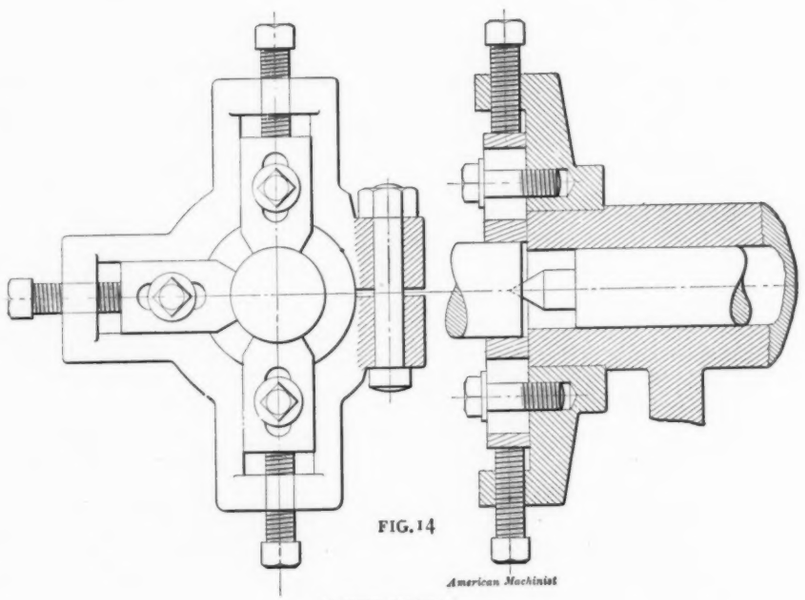


FIG. 14

American Machinist

LATHE DETAILS.

CONSTRUCTION OF ARBORS.

I firmly believe that all arbors should be made with taper shanks and be driven by a slot across the nose of the spindle, after the fashion of milling-machine arbors, and also that they should be supported at the tailstock end by some form of bearing beside the center. For this latter the suggestion of Fig. 14 is offered. This appliance is made to clamp around the extended nose of the tail barrel and has three jaws to take the weight and the pressure due to the tool, which will put the arbor in very much the same condition as in a milling-machine arbor.

If anyone doubts the efficacy of this proposed arrangement, let him fit a pair of centers to his milling-machine spindle and the overhanging arm and try running arbors between these centers driven by a dog. The effect, if his experience is the same as mine, will be to convince him that an arbor cannot be too well supported.

EXPENSIVE SAVING.

Oftentimes, too, the designer in making a piece cheap overdoes the saving in iron to an extent that makes it cost more to machine than it ought, as in the case of a gear blank shown in Fig. 15, which was a little over 8 inches in diameter, and since it was to be used only to transmit motion without any particular power, it was amply strong for its purpose if made as designed, but trying to turn it we could only nibble at it, as it was so weak in the arms that it chattered badly. Cut-

ting out the sand between the arms on an average of ⅜ inch thick added to the weight about 3 pounds and cut the time in half. Such instances are to be found in every shop, but they are not often looked after.

THE TAILSTOCK.

The design of tailstock has comparatively little to do with the subject now under discussion, as all parts are clamped firmly when taking cuts. It is only necessary to get the bolts which hold it to the bed as near the front, that is, as far toward the left-hand side, as possible. In such a job as boring a cone pulley for a lathe headstock, where we naturally bore with double end cutters held in a boring bar, which, in turn, is held by a taper shank in the tail spindle and runs through a straight bushing in the head spindle, it is very necessary that we should be able to move the tailstock quickly. If the tail-clamps or shoes are loose to swing, they are almost certain to swing enough to catch against the lathe bed and bind. After a little profanity the lathe hand learns to put one hand under the tailstock to push the clamp back at the same time that he does the tailstock. This is too barbarous a method, and is so easily overcome that it seems almost a pity to tell how. If the tail base is left as shown in Fig. 16, with narrow filing strips at *a a* and *b b*, so that these cross slots can be filed to fit the binder bolts, it will keep this swinging within small enough limits so that it will not bother. If, further, we cast the two clamps usually used above a 16-inch lathe in one piece by putting in a light connecting strip, as at *c*, they have still less of a tendency to swing.

THE BED.

Last, we come to the least important part of the lathe from our point of view—the bed. All lathe beds are "deep," "stiff," "with wide vees," "box ties," etc., but almost every one is made like Fig. 17 at *n*. Here we have the wide vees and the deep bed joined together by about ½-inch thick web on each side. Just why, if these thin webs are stiff enough, there is any need of putting so much bed below them, I cannot see. And if we must have so much bed, why not fasten the vees on it in some substantial manner? Beds of this form depend largely on the clamping of the headstock and tailstock to the bed for rigidity, and always have a bridge-piece across the top at both ends to help strengthen them and to prevent the customer from suspecting just how weak they are. The cross-section of the bed of Fig. 18 is only slightly modified from one that I used for several years. The ties as shown not only tie the sides of the bed together, but tie the ways to the bed itself. These beds are stiff enough without the bridge-pieces at the ends, and so can be strung along one after the other on a planer and planed clear through. Using this design, we were able to plane 5 or 6 feet 14-inch beds in about five hours apiece, without using any inducements in the way of piece work or premiums. For really stiff lathe beds, the ties should be very wide and spaced so that the space between them is equal to their width. It is noticeable that the form of bed shown in Fig. 18 will come out of the foundry with much closer iron in the ways than Fig. 17. This is due mostly to the fact that there is iron at or over *p p* to feed the ways instead of its immediately cooling at *n n* and drawing from the ways.

In conclusion, I wish to reiterate my belief that there is more room for advancement along modern lines in the design of the engine lathe than in any other tool built. The lathe is essentially an all-around tool, but that should not be made an excuse for making it a jack-at-all trades and good at none.

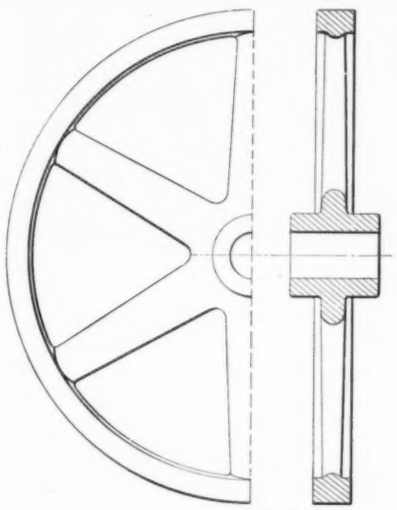


FIG. 15

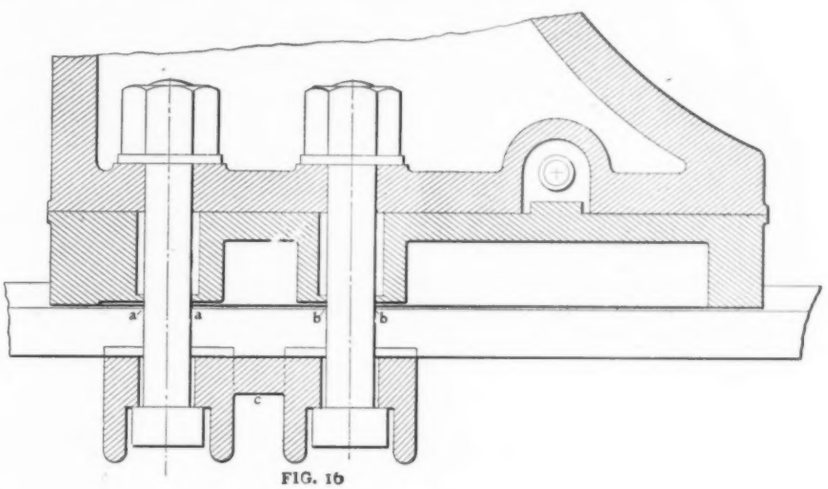


FIG. 16

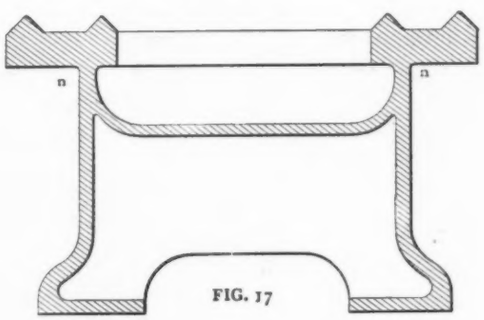


FIG. 17

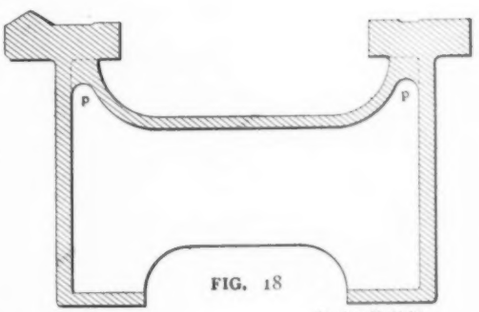


FIG. 18

American Machinist

LATHE DETAILS.

To the lay mind, the results of "the law" are sometimes strange. In these days of dodging automobiles at every street corner, we recently saw, on one of the avenues of this city, a road roller go clattering down the street at the pace of a very moderate walk, and marching ahead of it, at a distance of half a block, was a man solemnly waving a red flag to warn passers-by of their impending danger!

Some Pacific Coast Pump Manufacturing Methods.

EDITORIAL CORRESPONDENCE.

The accompanying illustrations from the Dow Steam Pump Works, of San Francisco, will serve to indicate that highly developed manufacturing methods in the construction of steam pumps are not confined to Eastern shops.

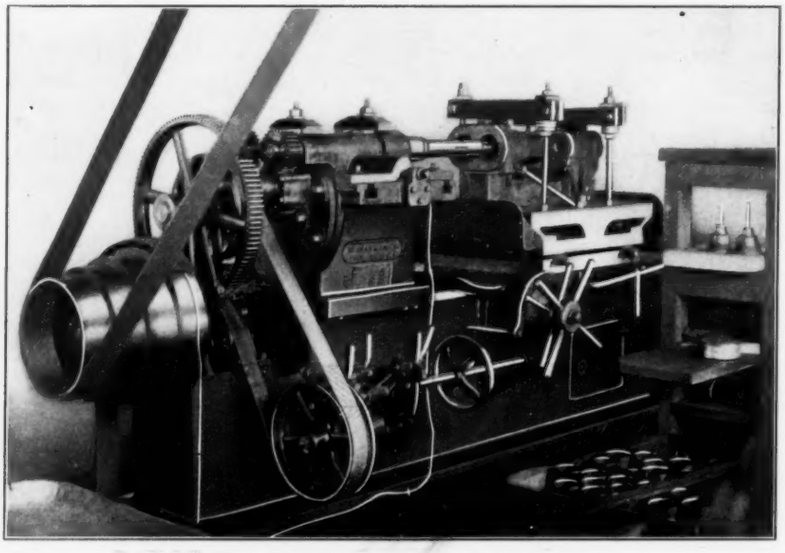


FIG. 2. TAPPING STUFFING-BOX HOLES.

Figs. 1, 2 and 3 show a machine for performing various boring and tapping operations on the cylinders of duplex pumps, the work instead of the tools being mounted on a turret in a manner which has a wider range of application than it has ever received.

Fig. 1 shows the spindle with a boring tool for boring the stuffing-box hole of the steam cylinder, while Fig. 2 shows a tap substituted for the boring tool. Fig. 3 shows the turret in the act of being turned around to present the water cylinders to the tools. The machine has two spindles for acting on both sides of the pump at once, though the position of the camera was such that the rear spindle is pretty well concealed by the one in the foreground. These spindles are adjustable in their distance apart to suit various sizes of pumps.

Fig. 4 shows a wholesale milling operation. The facing cutter shown in place on the machine surfaces the valve seats of the cylinders, after which the slabbing cutter shown standing on the near end of the platen is substituted for the facing cutter, and the cover faces of the cylinders are surfaced. F. A. H.

The new shops of the B. F. Sturtevant Co., at Hyde Park, Mass., are among those to which properly accredited and genuinely interested visitors are to be made welcome, and as may be judged from our description of them they are well worth seeing.

College Shop Experiences—VII.

BY HARRY MARQUETTE.

One day, during the spring break-up, the "Prof" was in the toolroom grading the students' exercises, when the door opened and "His Nibs" came in, more important than usual. After the salutation, he said, "I have a scheme by which you and I can make a barrel of money. You see, these folks out here have no knowledge of the theoretical side of engineering; I have written several firms in the East, and they have all offered a commission on any machines we can sell for them. Now, all we have to do is to hang out our shingle as a consulting engineering firm, and we will get more than we can do. In fact, I have one job on hand already."

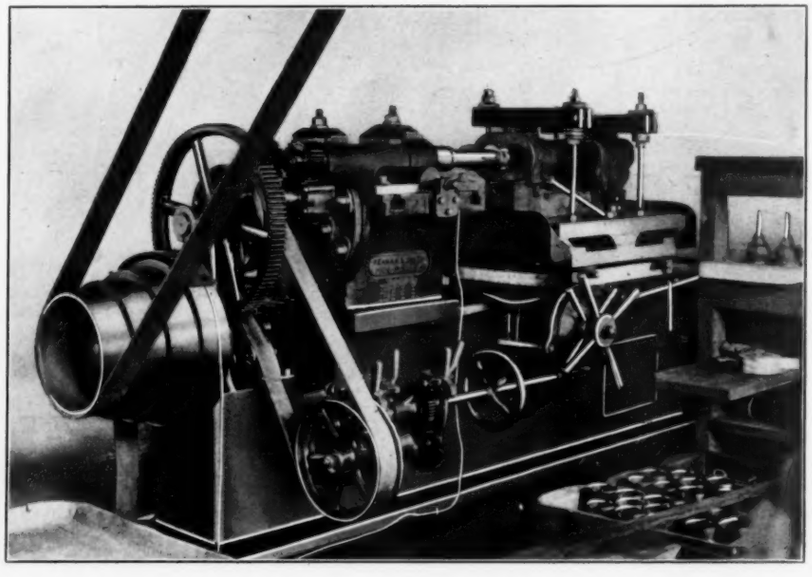


FIG. 2. TAPPING STUFFING-BOX HOLES.

The "Prof" had had enough experience with "His Nibs" by this time to be a little careful in the taking up of his schemes, and, as a consequence, set about finding out what the job was before committing himself as to the shingle proposition. After considerable preliminary talk, "His Nibs" made the following statement of facts: "You see, the Bannock mine is located 350 feet above the river in the Gulch, and after the water in their reservoir plays out, they always have to shut down for from two to three months in the summer, on account of the fact that it is a dry mine, and they do not have enough water for the boiler of the hoisting engine. They want to put in an electric light plant at the mine, too, where they can get wood easily for fuel, and then to put a pump driven by electric motor down by the river, so that during wet weather they can pump up the necessary supply of water. Now, they are pretty hard-fisted old codgers to deal with; but I find that it will not take a very big outfit or cost much money. They have already contracted for the new boilers, engines and dynamos for the mine, so we can't work them for the commission on that, but we can stick them for the pump and motor all right."

When asked how large a pump and motor would be required, the following rather surprising figures were given: "I find, by taking the number of gallons required and consulting a catalogue, that a triplex power pump having three single-acting pistons, each 4 inches in diameter and an 8-inch stroke, will put up the required amount of water, and also be capable of giving them some for fire protection. The area of a 4-inch circle is 12.566 square inches. Multiplying this by the stroke, or 8 inches, we have 100.528 cubic inches. As each piston makes 80 strokes per minute, we would have each piston

moving 100.528 × 80 = 8,041.84 cubic inches. As there are three cylinders acting, we would have three times this, or 24,125.52 cubic inches of water passing through the pump per minute. Reducing this to cubic feet, we would have 14 cubic feet. As each cubic foot of water weighs 62.5 pounds, we would be moving 14 × 62.5, or 875 pounds of water per minute. Multiplying this by 350 feet, the necessary rise, we have 305,250 foot-pounds of work required per minute. If we add 10 per cent. to cover losses in gearing, friction of pipes, etc., we would have 335,775 foot-pounds. Dividing this by 33,000, we find that our pump only requires 10.175 horse-power. As a 10 horse-power motor is capable of taking care of some overload, it would be ample for this purpose."

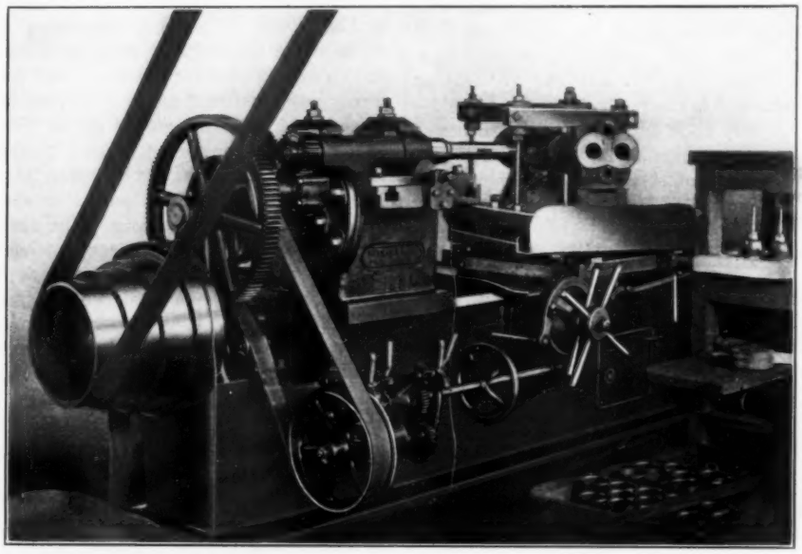


FIG. 3. REVOLVING THE WORK-HOLDING TURRET.

The "Prof" had listened and followed the calculations with his slide rule to this point, and had determined that he had no use for any shingle business for such calculations, if such small friction factors were to be included in the business. When he got a chance to get a word in edgewise, he said: "But your friction losses in gearing and pipes will be nearer 50 per cent. than 10 per cent." The reply was: "Oh, you are surely mistaken; 10 per cent. would be ample for this case." Then followed a debate of half an hour upon the subjects of coefficients of friction; but "His Nibs" would not raise his 10-per-cent. factor one particle. The "Prof" announced that he did not want to go into the shingle business, and would let "His Nibs" have both the profit and the glory.

The motor and the pump were installed. "His Nibs" had wanted the company to run a 5-inch pipe line up the hill, but they ran only a 4, which, according to ordinary hydraulic principles, would certainly be considered ample. Disinclination prevented the "Prof's" being present when the outfit was first tested, though "Red Frank" gave a very good description of it, as he had assisted "His Nibs."

In his usual cock-sure manner, "His Nibs" threw the switch and started the motor. The pump responded promptly, and started chugging away at a good rate. In about a minute, however, the pump commenced to slow down, and in less than two minutes stopped. "His Nibs" forgot to turn off the electricity, and as the men stood looking at the pump, wondering what was the matter, they were much surprised to see it start up again, make six or eight revolutions, and stop once more. This was repeated at intervals of about five minutes. After waiting some time, a man was sent to the top of the hill to see if any water had appeared there; but he found that none had.

That evening the "Prof" stopped at the college engine-house and got the story from "Red Frank." A few minutes later "His Nibs" came in and asked the "Prof" to go up next day and try to locate the difficulty, stating that he was very sorry, indeed, that he could not go himself, as he had some very important work on hand. The "Prof" set out the next morning with a wagon, "Red Frank" and some equipment. As it was vacation time at the college, he borrowed a 20-horse-power induction motor from the shops; he also took a breast drill, a small tap and a number of small pipe plugs. The pipe from the pumping station to the mine was exposed, as it passed over rocky ledges where it could not be buried.

The pump was started, and "Red Frank" left to watch it as it made its alternate starts and stops at intervals of about five minutes. The "Prof" went about two-thirds of the way up the hill and there drilled a hole in the pipe, and continued drilling holes at about ten-foot intervals. In a short time a point was found at which water appeared periodically, and a few

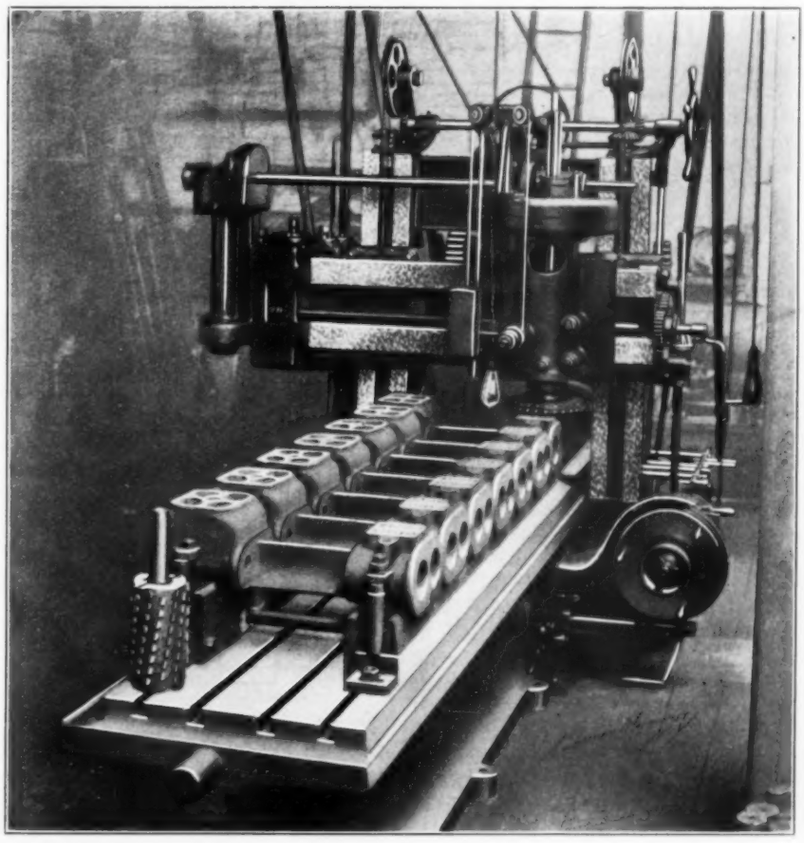


FIG. 4. A WHOLESALE MILLING OPERATION.

feet below this a point where it flowed continuously. From this it was evident that the periodic action of the pump was due to the fact that when the water reached a certain height in the pipe the pressure on the piston, together with the friction of the machinery and pipe line, was sufficient to stall the motor. The pump valves were not absolutely tight, and hence allowed some of the water to leak out. This soon reduced the pressure to such a point that the motor was able to start up and drive the pump until the water pressure and friction were again sufficient to stall it, thus causing the periodic action.

The holes in the pipe were then tapped and plugged, and with the help of a couple of the mine men, the 10-horse-power motor was taken out and the 20-horse-power substituted for it. As it was a belted installation, this change could be made without difficulty. As soon as the new motor was in place the current was turned on and the pump ran continuously, delivering the desired amount of water at the engine house.

When the mine superintendent asked the "Prof" where the difficulty was, he simply replied: "You will have to get the man that sold you the outfit to explain that, as it was not my job."

The lack of engineering knowledge on the part of the mine superintendent, and the talking propensities of "His Nibs," may be inferred from the fact that he talked that mine manager into believing that the use of the 4-inch pipe line in place of the 5-inch pipe line proposed by him was the cause of all the difficulty. He also got the mine to pay the difference between the price of the 10- and the 20-horse-power motors and the extra sum to cover the cost of changing from one to the other.

Letters to the Editor.

Making a Master Templet.

Frequently in die work a templet is required having some of the characteristics of the one shown in Fig. 1, the outline of which happens to be symmetrical with respect to the center lines *A B* and *C D*. The four holes marked *H* are also symmetrically located and the rectangular opening *I* is central both ways.

A very good and rapid way to make an accurate templet of this kind is to lay off on a piece of sheet metal and file out to the lines as closely as possible, a master templet like Fig. 2. This has the outline of a quarter of Fig. 1. One of the four holes *H* is also laid out and drilled smaller than the size required in the templet and as closely in its correct location as careful drilling will bring it. On the center line *A B*, Fig. 2, are laid off and marked with a center punch the two holes *G G*, which may be any distance apart, but must be equally distant from line *C D*.

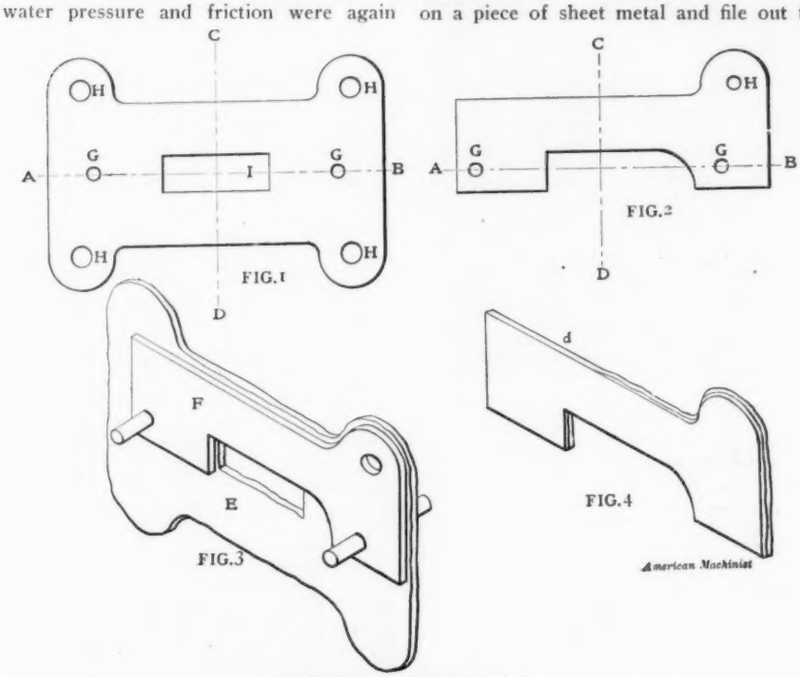


FIG. 1. FIG. 2. FIG. 3. FIG. 4.

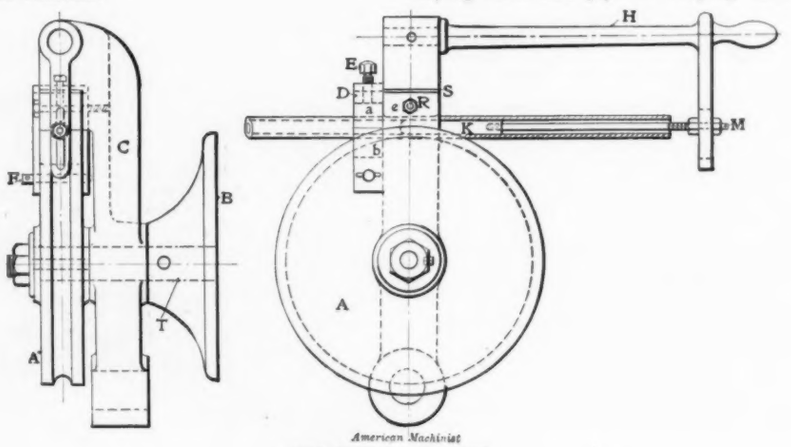
MAKING A MASTER TEMPLET.

This master templet is now clamped to the piece of sheet metal from which the templet is to be made, and the holes *G G* drilled and reamed through both, using a size that will closely fit a convenient size of drill rod. Placing in these holes two pins from the chosen size of rod, as shown in Fig. 3, the outline may be scribed on the sheet-metal piece *E* by marking around the master templet *F* in each of four different positions on the pins. Having removed *F*, *E* is then roughed out as close to the lines as convenient. Again placing together on the pins and gripping in a vise, *E* is filed down flush with *F* in each of its four different positions. The opening *I* may be filed out in the same manner. At this stage we have the templet as in Fig. 1 exactly symmetrical with respect to *A B* and *C D*. It is now ready to be tested for exactness to size. The width may be calipered, and if found too wide a little may be filed from the side of *F* and one side of *E* while together on the pins; then by reversing *F* exactly the same amount may be filed from the other side of *E*, repeating this until the correct width is obtained. The correct length may be obtained in the same manner and evidently the same procedure will bring the opening *I* to exact size and shape and in the exact center of the piece. It is of course essential that the master templet at first be (if not exact to size) over size.

H. B. McCabe.

A Pipe-Bending Fixture.

For bending copper or brass tubes I have found the fixture described below convenient and practical. For bends of varying radii and pipe of varying diameters the disk *A* is made to suit each arc and outside diameter of pipe, respectively. To compensate for this difference of diameters the arm *C* is constructed with two hubs, bored to fit shaft *T*. The friction block *e* and clamping dies *a* and *b* are made for each diameter of pipe, the latter being secured to disk *A* by the pin *F*. The base-plate *B* is bolted to the bench. Shaft *T* is pinned to *B*. Disk *A* is keyed to *T*, while the arm *C* is fitted to swing upon it.



PIPE-BENDING FIXTURE.

Arm *C* carries the friction block *c* and the handle *H*. The shim *S* is removed when taking out the pipe, after it has been bent to the desired shape, to allow *c* to be drawn away from the work. *R* is a bolt passing through an elongated hole in *c* and screwing into *C*. When bending the pipe it is prevented from collapsing by the follower *K*, which is drawn forward by the rod *M*, this rod being adjustable to the various sizes of disks by a slot cut in the projection on lever *H*.

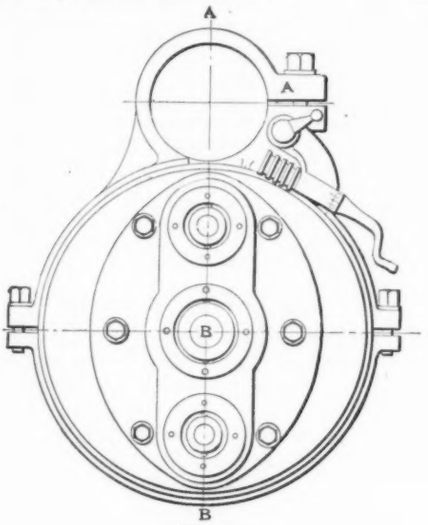


FIG. 1
Front Elevation

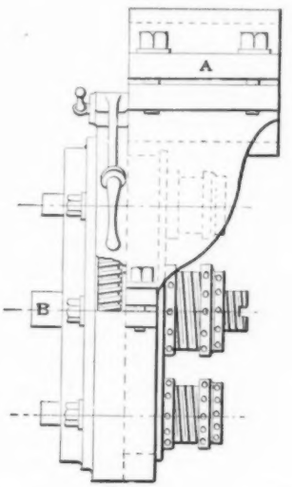


FIG. 2
Side View

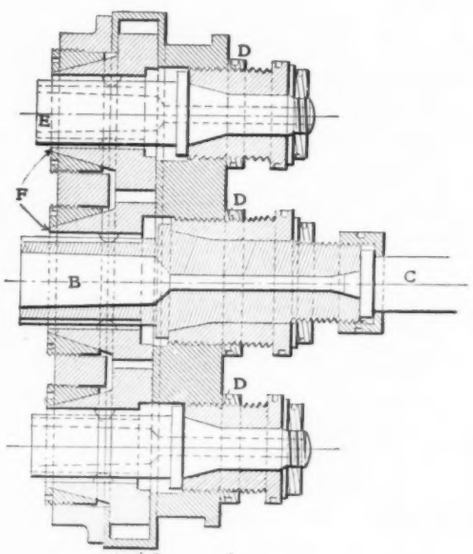


FIG. 3
Section through Head on line A-B with Casing removed

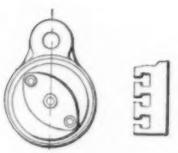


FIG. 4

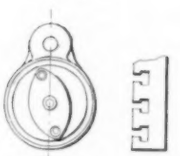


FIG. 5

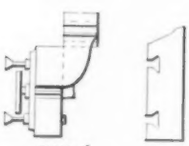


FIG. 6

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THREE-SPINDLE ATTACHMENT FOR THE MILLER.

The pipe is prevented from slipping by clamp dies *a* and *b*, set firmly down by set-screw *E*. To remove the pipe after the operation, screws *E* and *R* are loosened and pin *F*, shim *S* and the outside nut on rod *M* are removed. Moving lever *H* forward until the rod *M* is free of the lever, the pipe can then be drawn out and a perfect bend is the result.

When making a quantity of duplicate pieces, a gage is applied to rod *M* for the length of the bend, and a pin or clamp is put on disk *A* to give the desired angle.

The object of the removable clamp *D* is to facilitate making a bend of the form of an S, or more than one bend at whatever angle may be desired on the same piece.

Jos. N. Germain.

A Three-Spindle Milling Attachment.

A three-spindle attachment for milling machine is shown in the accompanying drawing, of which Figs. 1 and 2 represent the front and side elevations of the complete device, while Fig. 3 is a sectional view. The device is clamped to the milling machine by fastening the bracket *A* to the overhanging arm. The central or main spindle *B* is driven by the spindle of the machine to which the head is attached, by means of the taper arbor *C*, this arbor being fastened to the spindle of the attachment by a locking cap as shown in Fig. 3. Each of the three spindles is longitudinally adjustable independently of the others. The adjustment is made by screwing the rear bearing in or out of the housing as the work may require, and then locking the spindle in place by the check nut *D*. The small spindles *E* are driven from the main spindle by the gears *F*.

Fig. 1 shows part of the supporting bracket cut away in order to expose the graduation, as well as the gashing for the worm; the former is to be used as a reference in the oblique adjustment of the attachment, the latter to make minute adjustments of the attachment when milling to gage, the worm having a graduated collar reading to minutes.

Figs. 4 and 5 show the attachment set for cutting three T-slots, which in one case are close together and in the other further apart. The rotation of the head is sufficient to obtain a considerable variation in the distance between slots.

Fig. 6 shows the device as equipped for cutting dovetails, finishing the several surfaces at the one cut. Various forms of dovetails, T-slots, grooves, trumions, etc., can be worked out in similar fashion. Obviously the same cutters may be used in many cases for milling parts to fit together, a slight rotation of the head giving the necessary play in the finished piece and the same method compensating for wear, reduction of size by grinding the cutters, etc. The cutters for these different purposes may be of various sizes and this necessitates proportional speeds.

The device is therefore provided with means of inserting change gears when the central cutter is larger or smaller than the others. This contrivance will be found to be more useful for factory than jobbing purposes.

Smoky Lamp.

Secret Processes in Machine Shops.

Hobbs runs a small shop making a device wherein there is a detail which requires great accuracy, and yet the cost must be kept down to what he calls the lowest possible minimum. Hobbs is a resourceful fellow, and has arranged very ingenious means for producing these parts.

The other day I happened in on Hobbs, and after looking over one of his special rigs, I said, "Hobbs, suppose I make a sketch of this and write a description for the American Machinist." "Suppose you don't," says Hobbs. "I don't want every Tom, Dick and Harry to get next to my scheme for doing this job. If my competitor knew this he would copy it and do the work as cheap as I do. There was a fellow in here once from the American Machinist, rubbering around and wanting to sketch this and write it up, but I turned him down. Your Uncle Fuller isn't sitting up nights wearing out his thinking-tank for the benefit of the craft."

Now, the fact is that Hobbs has no com-

petitor making a device with the same form of detail as he uses, so his argument here doesn't stand. Hobbs figures the proposition like a great many other manufacturers, both large and small; yet there are enough concerns left, who allow their methods published, to give us some very interesting reading along this line.

Manufacturers evidently keep their methods secret through fear of stimulating manufacturing along similar lines—to keep down competition—but I doubt very much if the new concern which starts has procured its information from reading matter. Most new concerns are the outgrowth of older ones, and are started by men experienced in certain lines. If a workman becomes experienced in making sewing machines, it becomes a sort of a hobby with him, and in ninety-nine cases out of a hundred, if he starts in business, especially manufacturing business, he will make sewing machines. Now, the man who has begun to make sewing machines has read a great deal about some very good ways for making parts of lawn-mowers economically, yet he prefers to make sewing machines. If he must start into business for himself, he is sensible in following this course, because it is hard enough to make it successful, I am told, even if you know what you are doing.

At the same time, I believe it is beneficial for the sewing-machine man to know what the lawn-mower maker is doing, because it will broaden him and doubtless show principles which can be applied to his particular work.

When a cub, I used to think that if I could only see micrometer screws chased and scales graduated my mission in life would be fulfilled. It seemed to me that a man capable of designing and building a machine to do these things was certainly above reproach, and I longed to meet a man so gifted. It has occurred to me in later years that possibly this man was not altogether perfect. I have also acquired the belief that more than one man can accomplish the feat referred to; there are doubtless several hundred designers in this country who could do this task if they were called upon.

Methods of graduating scales are not shown often—that is, they are not shown to me—but if I saw a machine for doing this work, and if I had the capital to equip a plant, I would not make scales.

Not long ago I was talking with a salesman, who told about how a rival concern was manufacturing cutters—formed cutters for gear teeth—by using cutters purchased from "us," as he put it, to make their forming tools, because they could not obtain the original tooth curve without "our" cutters. It was the first time I had ever known that the involute or epicycloidal curve could be generated at but one shop, and the information was doubly reliable because it came from the salesman.

The men who work out the designs for these special tools deserve a great amount of credit, and I do not wish to detract. If they had their own way about it, I believe we would all see a great many "secret processes" laid bare.

ART ISAN.

Table of Sizes to Three-Quarter Scale.

Sometimes in designing new work it is more convenient to work to three-quarter scale than to half or to full size. However, a difficulty is apt to arise about getting the dimensions accurate. I overcame this difficulty by computing a table of three-quarter sizes in fractions of an inch and decimal equivalents, a copy of which I send you. It may help someone else out of a like difficulty. This table is calculated to eight decimal places in order to give a correct result to .0001 inch when the square root of a number had to be taken.

G. R. CAROTHERS.

1/64	.01171875	1/32	33/64	.10546875	17/32	1/64	.19981875	25/32	33/64	.29296875	37/32	1/64	.38671875	49/32	1/64	.48046875	61/32	1/64	.57421875	73/32	1/64	.66796875
1/32	.0234375	3/64	1/16	.1171875	9/32	3/64	.2109375	13/32	3/64	.3046875	19/32	3/64	.3984375	25/32	3/64	.4921875	31/32	3/64	.5859375	37/32	3/64	.6796875
3/64	.03515625	1/16	17/64	.12890625	9/32	1/16	.22265625	7/16	1/16	.31640625	5/8	1/16	.41015625	13/16	1/16	.50390625	1	1/16	.59765625	1 3/16	1/16	.69140625
1/16	1/8	1/16	9/64	1/8	5/16	1/16	11/64	3/8	1/16	13/64	7/16	1/16	15/64	1/2	1/16	17/64	9/16	1/16	19/64	5/8	1/16	21/64	11/16
5/64	.05258375	3/32	19/64	.15234375	11/32	3/32	.2469375	15/32	3/32	.33984375	21/32	3/32	.43359375	27/32	3/32	.52734375	1 5/32	3/32	.62109375	1 9/32	3/32	.71484375
1/32	.0703125	1/16	5/32	.1580625	5/16	1/16	.2578125	1/2	1/16	.3515625	11/16	1/16	.4453125	7/8	1/16	.5390625	1 1/16	1/16	.6328125	1 1/8	1/16	.7265625
7/64	.08203125	1/32	21/64	.17578125	23/32	1/32	.26353125	27/32	1/32	.36328125	29/32	1/32	.45703125	15/16	1/32	.55078125	1 7/32	1/32	.64453125	1 5/16	1/32	.73828125

[The right-hand figures are ¾ of the dimensions in the left-hand columns.]

TABLE OF SIZES TO THREE-QUARTER SCALE.

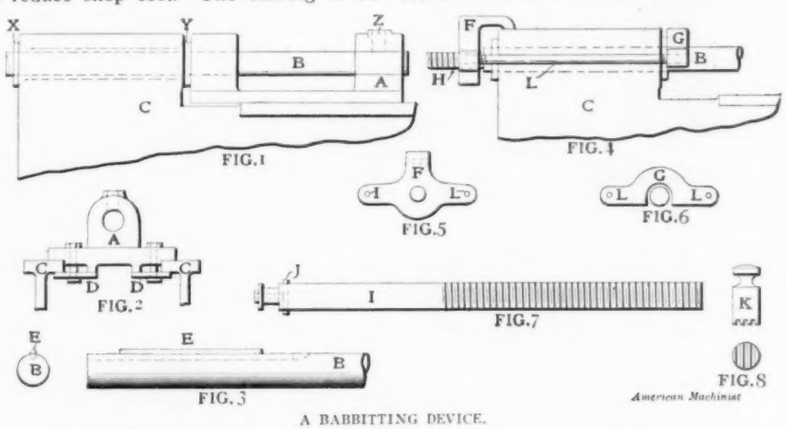
A Babbitting Device.

The babbitting jig described is the result of a limited shop equipment and an effort to reduce shop cost. The bearing to be babbitted on bed *C*, Fig. 1, is solid, as shown, thus eliminating the planing and fitting of a split bearing and also doing away with the extra cap-screws. It was babbitted and bored with the fixture because the shop at that time had no boring mill suited for the job. However, it has proven so satisfactory that even with a complete shop equipment I doubt if this method would be changed, as it is done so cheaply and makes so substantial a job that it seems hard to improve upon.

Babbitting bar *B*, Fig. 1, is held in the fixture *A*, which is in turn clamped to the bed *C* by the clamps *D*, as shown in Fig. 2. The collars *X* and *Y*, Fig. 1, are to retain the babbitt while being poured, the collar *X* having a gate to admit the metal. The babbitting bar *B*, Fig. 3, is slotted and fitted with the loose key *E*, which forms the oilway in the bearing. The key *E* is made the length of the bearing, but projects above the bar *B* for the length of the oilway desired only, and from there on the ends are turned down flush with the shaft. It is held in place by the collars *X* and *Y*. While bar *B* is being removed, the key *E* remains fast in the bearing, after which it is easily pulled down and out.

The device for removing the bar *B*—after the babbitt is poured—is shown at Fig. 4. The brackets *F* and *G* are held together by the rods *L*, these rods being threaded at the ends by opposite hand threads which are screwed into the brackets. When the device is in position, the bracket *G* rests on the bar *B* and the bracket *F* on the bed *C*, as shown. The bracket *F* is threaded to admit the screw *H*, which is squared at the opposite end for the use of a wrench or crank. The bar *B* is then forced out with the screw *H*. Figs. 5 and 6 are end views of the brackets *F* and *G*.

The bar *B* is made 1-16 inch smaller than the finished hole. After the bar is removed the bar *I*, Fig. 7, is placed in the base *A*, Fig. 1, and into the hole *Z* the pin *K*, Fig. 8, is dropped. The bar *I* is threaded with a square thread for a little greater distance than the length of the babbitted bearing. The pin *K* is grooved as shown to conform with the thread on the bar *I*, and when in place acts as a nut.



A BABBITTING DEVICE.

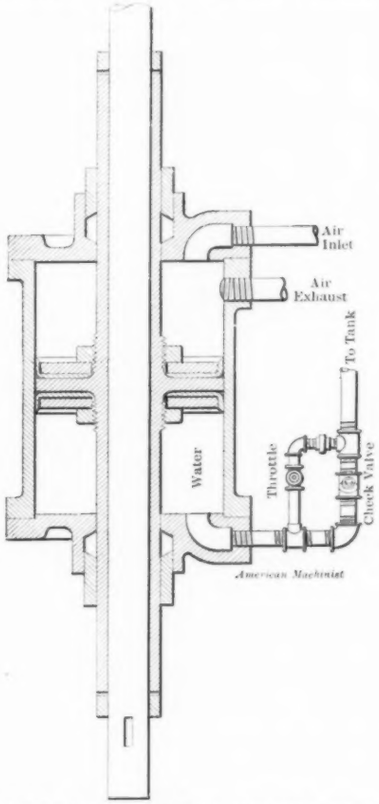
The pin *J* on the bar *I* is rounded on the ends, and is slightly longer than the diameter of bar *B*. This is run through the bearing, expanding the hole and compressing the metal, after which the pin *J* is removed and a cutter put in its stead, which roughs out the hole nearly to size. A reamer then follows, which completes the job. The reamer is placed on the end of the bar *I*—which is turned down—and is clamped against the shoulder with the screw and washer shown.

On first using the device we had trouble with the babbitt chilling when it struck bar *B*, which tended to make the metal full of holes and grooves. This, however, was overcome by pasting paper around the bar before pouring. Best results seem to be had by tilting the bearing to an angle of about 30 degrees. The bearing when finished is all that could be desired.

L. F. B.

Pneumatic Feed for a Multiple Drill.

There having been considerable interest shown in the boring, or drilling, machine equipped with pneumatic feed, I enclose a



PNEUMATIC FEED FOR A MULTIPLE DRILL.

small drawing giving the principal features of one of the spindles.

As may be seen by the sketch, air pressure is used for the feed, while water, flowing through a throttle valve, restricts the speed and, by way of the large inlet pipe, makes a quick return of spindle.

The water pipes from all the cylinders lead to a common header and thus to a tank located high enough to give the pressure required. This feature thus becomes entirely automatic, and the only water lost is by leakage or evaporation.

Both the air inlet and exhaust pipes from all the cylinders lead to headers which are connected with a three-way valve, thus requiring only one valve to operate any number of spindles. At present this valve is opened by hand and closed automatically at the end of the cut.

DRAFTSMAN.

The Distribution of Catalogues.

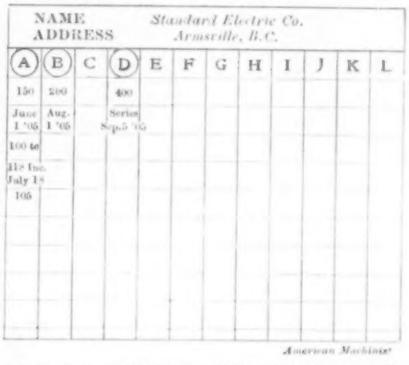
At the present day, in the manufacture and sale of machinery of every kind, the preparation of suitable catalogue and advertising matter and its wise distribution require more attention than ever before. While much might be written regarding the methods of producing modern catalogues, we will here draw attention to a method of distributing them, and recording such distribution, which may prove useful to others interested in the promotion of business as far as may be done by the circulation of printed matter.

We believe that every request for a catalogue or set of catalogues, however unpromising it may be as regards future business, should receive a full response. Furthermore, we believe that it is not wise to wait until those interested in our products write for catalogues. We aim to put a copy of our printed matter on any subject or line of goods in the hands of every desirable customer, likely to be interested, as soon as such circular, bulletin or catalogue is issued, and as fast as new prospective customers develop they should be supplied with all current matter likely to interest them. In order to carry out these ideas, it is necessary, of course, to maintain a list of names and addresses, and to the end that such a mailing list may be built up and handled conveniently, we have devised the following system:

We have adopted the bulletin method of issuing catalogue matter, although, as we use it, it is simply a sectional catalogue scheme. The various sections are as follows:

A—Engines, Boilers and Pumps.
B—Water Turbines and Accessories.
C—Sawmill and Wood-Working Machinery.
D—Power-Transmission Machinery.
E—Pulp-Mill Machinery.
F—Rock Crushing and Screening Machinery.
G—Hoisting and Winding Engines and Accessories.
H—Steam Appliances.
I—Miscellaneous.
J—Smelting Furnaces and Accessories.
K—Milling and Concentrating Machinery.

As usual in compiling a mailing list, the names of firms and individuals with whom we have or wish to have business relations are collected from various sources, such as the ledgers of the company, the daily correspondence, classified directories of trades, the trade journals, advertisements, etc., and are entered on standard 3x5-inch cards in the manner shown herewith. In the case of a very extensive business, 4x6-inch cards are to be preferred. The reverse side of the card bears the same letters and columns as the front. The cards are filed and classified in card-index drawers, between guide cards headed with the name of the business or occupation engaged in by the respective firms or individuals. Some sample headings are: Mining, Copper; Mining, Gold; Pulp and Paper Mills; Power, Water, Users of, etc., etc. When a name is to be listed, the name and address are filled in on the card and the letters indicating the classes of printed matter the firm is likely to be interested in are circled around in red pencil. The firm shown on the card herein is therefore considered as being likely to be interested in Engines and Boilers, Water Turbines and Transmission Machinery. Such printed matter only is therefore sent them, unless they express a wish for information on other products, or circumstances arise which make it desirable to add other markings or deduct any no longer of use. Each sectional catalogue or bulletin has printed on the last page a list of the various sections the printed matter is divided into, and the receiver is invited to send for other printed matter



CARD FOR CATALOGUE MAILING LIST—SIZE, 3X5 INCHES.

which may interest him. A mailing card is sent with every bulletin, for the convenience of the receiver in acknowledging receipt of the matter sent him, and this card also bears a list of the subdivisions of the printed matter and an invitation to check off any subject upon which he would like to receive our publications from time to time.

With a mailing list arranged in this manner, it is possible to add new names with a minimum of labor, and to maintain a classification for special circularizing, and at the same time to insure that all who may be interested in other products shall receive literature covering the same. For example, Pulp and Paper Mills is a separate classification, and in sending out

new circulars of pulp-mill machinery, it is not necessary to deal with any but the cards in that section of the file. In sending out an issue of turbine catalogues, however, which would be of interest to firms in a number of different lines, it will be necessary to turn over all the cards, sending a copy of the turbine bulletin to every firm or individual whose card has the letter "B" circled in red.

When a catalogue or set of catalogues is sent out, the date is entered in the column provided for that respective class of literature, as shown in the cut. The numbers shown are the bulletin numbers. These entries prevent waste of expensive catalogues by issue to parties already supplied. To maintain simplicity, we do not think it necessary to record the issue of single sheets or small circulars, simply the issue of catalogues or sets of catalogues or bulletins. As these latter cost from 20 cents to $1 or more, in circulating them extensively as is intended under this system, unnecessary duplication would grow into quite a loss.

The list is divided into two main sections, one the "Permanent Mailing List," and the other the "Transient." The last named has a plain alphabetical index. In it are placed the cards of individuals or firms from whom we expect no business, or to whom for any reason we intend to send no more matter; yet of the issue already made, we wish to have a record.

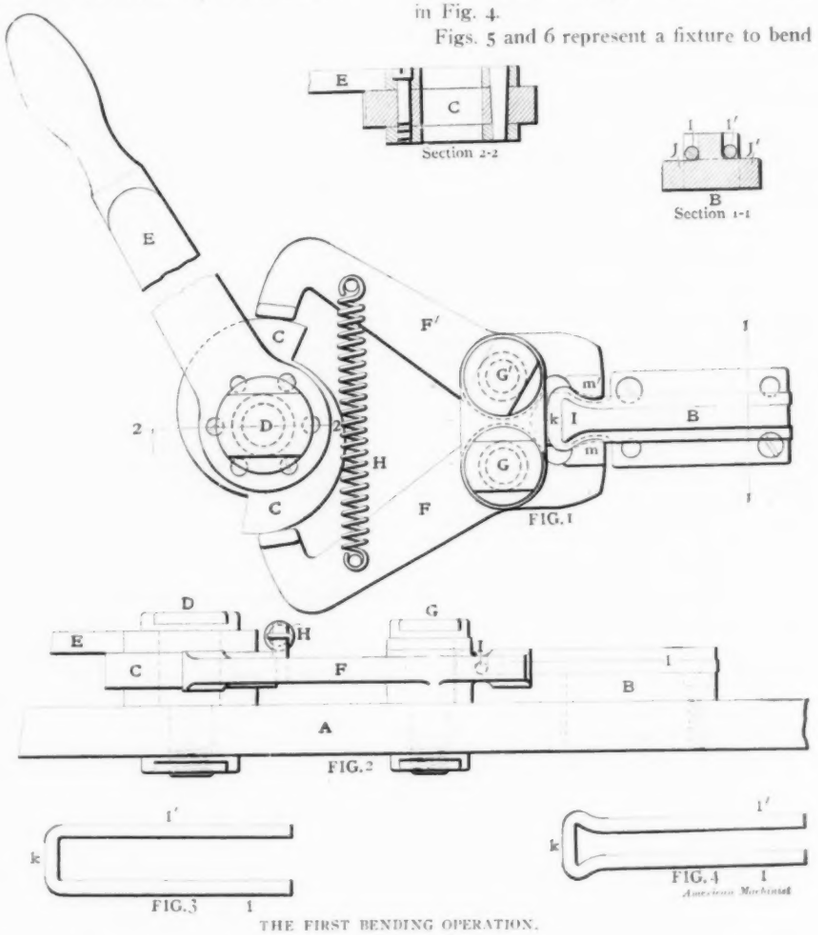
The system has been in use about a year. We find it very useful and convenient in mailing special circulars as well as new catalogues, and it takes very little time to keep it up when once it has been started. It may easily be adapted to any line of business, such as the manufacture of machine tools, steam pumps, electrical machinery, etc., and is suitable for use by small as well as large concerns. MAC.

Positions in Russia.

Having met, with two other Americans, with experiences that are uncommon in our own country, and being desirous of having others profit by them, I ask you to insert the following in your paper: Any American considering taking a position in Russia, should, before leaving his present position, be provided with an iron-bound contract stating specifically each and every point on which he desires protection. His failure to insist on the above will undoubtedly lead to his being placed in a very disagreeable position. This applies equally to each and every company doing business in Russia, whether American or European. DAVID MILLINGTON.

Two Hand-Bending Fixtures.

Hand-bending fixtures are often very essential parts of manufacturing outfits and for certain work are the only economical tools. The two hand-bending fixtures shown were devised by a tool-maker.



THE FIRST BENDING OPERATION.

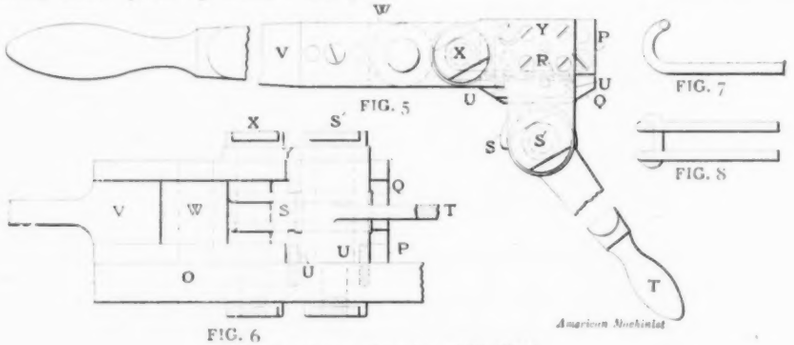


FIG. 6

THE SECOND BENDING OPERATION.

Figs. 1 and 2 represent a fixture which has for its base a flat plate *A*, upon which is securely fastened a form *B*, a double cam *C* being pivoted on the stud *D*, and operating by the hand lever *E*, gives motion to the levers *F F'*, pivoted by studs *G G'*. A strong spring *H* connects the levers *F F'* and causes them to retract when the cam *C* is turned backward. The form *B* is constructed with a forward part having a groove *I*, and has ledges *J J'*. The blank to be bent—which is represented at Fig. 3—is placed so that the portion *k* lies in the groove *I* and the parts *l l'* rest on the ledges *J J'*. The levers *F F'* are grooved at *m m'* to fit the wire of the blank, and when forced in upon the blank by the action of the cam *C*, the blank is brought to the form seen in Fig. 4.

Figs. 5 and 6 represent a fixture to bend the article at Fig. 4 into the form seen at Figs. 7 and 8. This fixture has also a flat plate for its base, which is lettered *O*, and upon which is fastened a rectangular block *P*, grooved at *R* to receive the blank which is clamped by the movable jaw *Q*, operated by cam *S* and hand-lever *T*, the screws *U* serving as guides for the jaw. A forked lever *V*, having a roll *W*, is pivoted at *X*, the pivot stud passing through a top plate *Y*, as does also the stud *S'* for the cam *S*. The blank having been clamped in position by the jaw *Q*, the lever *V*—having previously been brought to a position next to the jaw and at right angles to the blank—is swung and the blank is rolled into the form seen at Figs. 7 and 8. The studs *D*, *G G'*, *S'* and *X*, used for pivots in these fixtures, are very easy to make, of round

stock turned with a shoulder and threaded at the lower end. They are flatted by milling, so as to receive a wrench and have nuts made of round stock flatted in the same manner. C. D. KING.

An Inside Micrometer.

At page 1071, Vol. 27, J. S. V. Bickford expresses a desire for an inside micrometer having a range from 1½ inches down. I think I have found the tool he is looking for. The half-tone shows it assembled. Its capacity is from ½ inch to 3½ inches.

The two members *D* are made of flat-tool steel, .070 inch thick. The three holes .172 inch—a sliding fit for the end of the micrometer screw *L*. The swivel *A* is also provided with an adjusting screw *I* to take up wear.

The swivel *B* is bored .250 inch—a sliding fit for *A*. The rear end of *B* is threaded at *J* to form a nut for the micrometer screw. The outside is .310 inch diameter, and is graduated as shown in the half-tone, the inch spacings being, of course, only ½ inch apart because of the two-to-one ratio of the legs *D*.

The thimble C is bored .310 inch to fit over *B*. It is .40 inch outside diameter, and is secured to the micrometer screw in the usual way. The micrometer screw

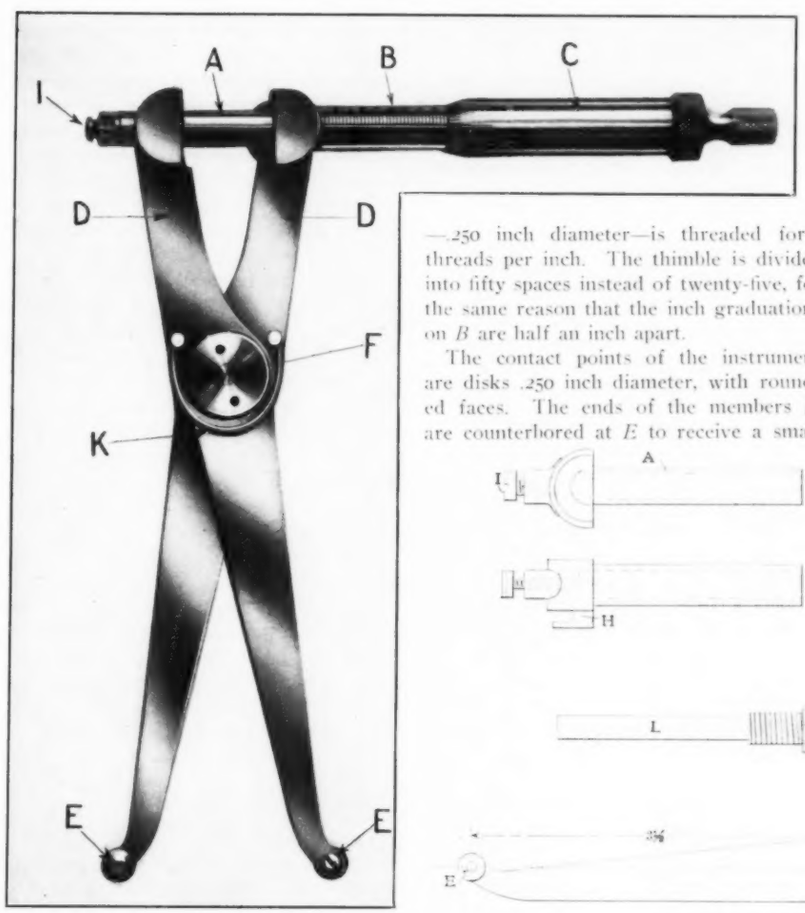


FIG. 1. AN INSIDE MICROMETER.

—.250 inch diameter—is threaded forty threads per inch. The thimble is divided into fifty spaces instead of twenty-five, for the same reason that the inch graduations on *B* are half an inch apart.

The contact points of the instrument are disks .250 inch diameter, with rounded faces. The ends of the members *D* are counterbored at *E* to receive a small

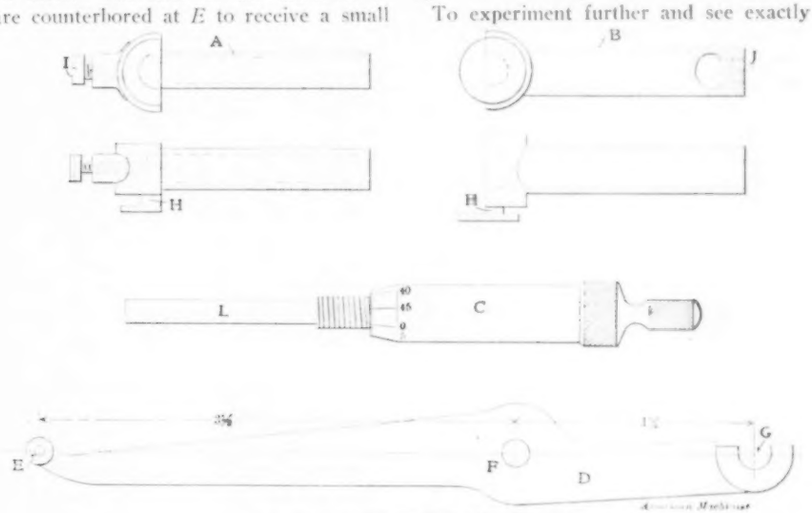


FIG. 2. THE PARTS OF THE MICROMETER.

E F G are drilled in line, the distance from *E* to *F* being twice the distance from *F* to *G*. The locating and finishing of these holes must be done with the greatest care, as upon them the accuracy of the tool is to a great extent dependent.

The upper parts of the members *D* are filed away, so as to leave *G* a little more than half a hole. The trunnions *H* of the swivels *A* and *B* fit in the holes *G*, and the swivels *A* and *B* cannot fall out of *G* unless they are swung around in line with the members *D*.

The swivel *A* goes in the left member *D*, as shown in the half-tone. Its barrel is .250 inch outside diameter, and is bored

projection on the side of the disk, which is fastened in place by a small machine screw. When a disk becomes worn, it may be turned around so as to present a new face to the work. The U-shaped spring *K* keeps the end of the micrometer screw *L* in contact with the adjusting screw *I*.

With this tool, measurements within a limit of .001 inch may, with practice, be made. Owing to its lack of balance, it is not, however, a handy tool to use. It was made for his own use by Edward Board, 618 Chestnut street, Philadelphia, to whom I am indebted for the loan of the tool while I wrote this description. DIXIE.

Some Gear-Cutting Experiences.

In looking over the back numbers of the AMERICAN MACHINIST I was surprised to see how few articles had been written on gear cutting; I should like to give a bit of my experience in this work, and perhaps this will inspire others to do likewise.

When we got our first automatic gear cutter, about four years ago, I remember with what profound respect we, of the shop, eyed it over, and also with what care the machine was operated so that it would not be strained or broken by overwork. One of the first jobs we did was a 61-tooth by 3½-diametral-pitch gray-iron wheel about 3¼ inches wide. I remember quite well that this blank was put on one Friday afternoon and taken off the following Friday, after nearly fifty hours' continuous cutting. It was plain that something must be done to alter this, or it would pay us better to send our gear cutting out, as we had previously done. I should judge that in the above example the feed was about ¼ inch per minute; the cut going around the blank two or three times.

The first change we made was to stock out the blank with a ¼-inch wide milling cutter, and by doing this we reduced the time to just over twenty hours. The rate of feed was still very small, but by degrees, as we gained confidence, we worked up to the fastest speed of the feed cones.

To experiment further and see exactly what the machine would do, we put a pair of pulleys on in place of the feed cones, which increased the feed by about 50 per cent. We then fitted a double-thread feed worm in place of the single-threaded one then in use, and after a bit found it was possible to use the pulleys on some sizes of gray-iron gears, the cones being required, however, for steel and the larger pitches in gray iron. To do away with this changing from pulleys to cones and *vice versa*, we had a four-lead feed worm cut, so that we could keep the cones on, and at present the machine is nearly always working on the fastest feed.

The fastest feed for each of the five

spindle speeds is 2.8, 3.7, 4.7, 5.9, and 6.9 inches per minute. We now cut four pitch teeth in gray iron at one cut from the solid, and this we do at the rate of 3.7 inches per minute, with the cutter (having nine teeth) making 44 turns per minute. Our latest record is to cut a 146-tooth by 4-diametral-pitch wheel 2¼ inches wide, of gray iron, in four hours, a creditable performance, we think, and a big improvement over the example mentioned above. We have not yet tried the pulleys together with the four-lead worm on the larger pitches, but we have cut 12 diametral pitch with them, which gives a feed of 9½ inches a minute, with the result that we had to sharpen the cutter every fifty or sixty teeth; also the ends of the teeth where the cutter broke out were dreadfully smashed up, so we concluded that we were feeding too fast.

A point that must be attended to, if a moderately fast feed is used, is the truth of the cutter; if the cutter does not run true, then one or two teeth have to do all the cutting and are very quickly dulled. If the machine is not stiff enough (this is the cause of our not being able to feed still faster) the result is the same; all the parts spring away from the cut and then jerk forward at every revolution, bringing all the work onto one or two teeth, as in the case of a faulty running cutter.

Another point which is of vital importance is the sharpening of cutters; if they are left running too long without grinding they will be badly rubbed, and will necessitate a lot of grinding to restore the edge, which will not only cause a loss through grinding the cutter to waste, but will also mean a considerable loss in time taken to *grind* the cutter, as compared to the time taken simply to *sharpen* it. The Brown & Sharpe Company, in their treatise on gearing, recommend that gear cutters be sharpened regularly at certain definite periods (every two hours) whether they require it or not; this is a good proceeding and no doubt saves a lot of time that might be lost if the cutters run too long without sharpening.

Another little kink in the grinding of cutters which may be new to some of your readers is in the method of holding them to the wheel: In the larger pitches, say over 5 pitch, we use the periphery of the wheel instead of the side; this, besides being a quicker job in the grinding, gives a smoother cutting cutter; for, the faces being hollow, the sides of the cutter have a keener cutting angle so that less power is used in operation and more work can be done without sharpening because there is less tendency to rub.

We have installed in our works a No. 6 Brown & Sharpe gear cutter, and this makes our original machine look small, indeed. The two machines are as dissimilar as two machines for the same work could possibly be; for instance, the smaller machine has a cone pulley for a 2½-inch belt and geared about 3 to 1, while the Brown & Sharpe has a 7-inch driving belt and is geared 15 to 1, yet we have had the belt knock off, which speaks volumes for the strength of the machine.

I might say that on this machine we cut change wheels of 6, 7 and 8 diametral pitch at a feed of 8 inches a minute; they are mounted on the spindle six at a time, the total length of cut being about 7½ inches. We cut six of these wheels having 120 teeth in just over two hours. The cutter is sharpened for every lot; it is about 4¼ inches diameter, runs at 40 revolutions per minute, and was made by Cammell, Laird & Co. from their 0172 steel.

I hope we shall have some more opinions on this most interesting subject.

Y——, England. G. EAR.

An Interesting Milling Operation.

The large angle piece shown in Fig. 1 furnished an interesting milling-machine problem in a small jobbing manufactory with which I was once connected. This angle was required to be finished on three sides of both legs, and when finished was as shown in section in Fig. 2. Each leg was about 4½ inches across the face, ⅝ inch thick and 17 inches long. On account of lack of tools but two methods were available, one in which the planer was used, the other the method here described. It was deemed impracticable to use the planer for the following reasons:

1. A comparatively large number of pieces (500 to 1,000) were to be made.

2. Each was required to be a duplicate of the other.

3. Only a reasonable cost could be allowed.

While it is true that the work might have been done accurately in the planer, and at a reasonable cost, the lack of a competent man and the closer superintendence required made the milling machine the preferable tool.

That which makes the adopted method of interest, is the fact that the work was passed over the cutters instead of under them, as is ordinarily done. By taking a roughing cut nearly to size and following it up by a finishing cut without taking the piece from the fixture, a very nice piece of work was obtained. It was not required to be extremely accurate, but it was necessary that each piece be square within a few thousandths in the length of 17 inches. The angles were finished in this way at the rate of twenty a day by an ordinary milling-machine hand.

In Fig. 1, *A* is the angle having its two legs *B* and *C* at right angles to each other. The section of one leg in Fig 2 is along line *a—b*. *D* in Fig. 1 is the gang of cutters with which the work was done. The arbor which carried the cutters was supported at its outer end by a brace fastened to the knee of the machine, the overhanging arm not being available because of interference with the work. *E* is a heavy gray-iron angle plate, overhung to allow the cutters to clear the work in setting up and before starting. *F* is a removable vise in which the work was securely held. *G* is a heavy tailstock, also overhung, carrying screws supporting the outboard end of the work. These screws were provided with fine hardened points which were embedded in the casting, thereby holding it very securely. After one leg of the angle was finished, vise *F* was taken from the fixture and another vise similar, but planed to fit the finished leg, was substituted for it and the operation repeated.

Had a vertical milling machine been available, a somewhat stiffer holding fixture might have been made, but the results obtained by the above method were entirely satisfactory and within the limits of accuracy required. L. A. MURRAY.

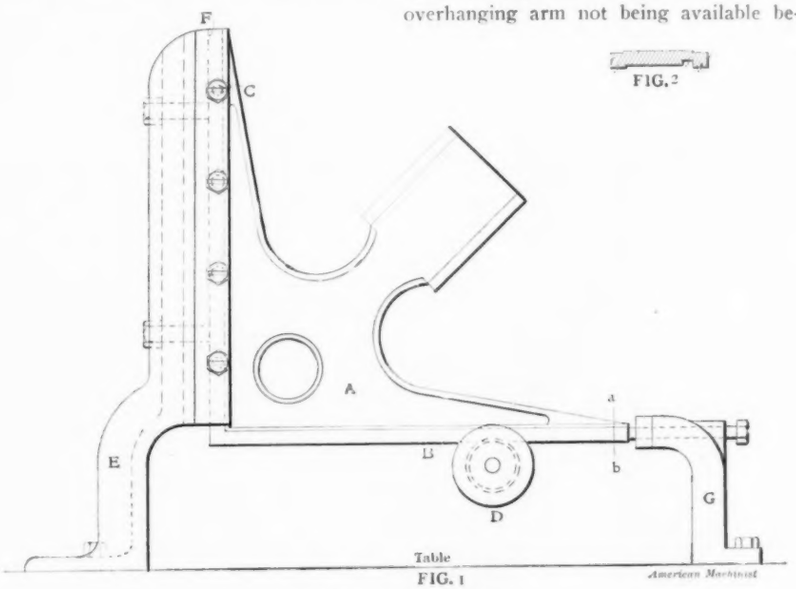


FIG. 2

FIG. 1

THE MILLING OPERATION.

Water-Wagon Design.

I recently saw a striking illustration of the difficulty we have in breaking away from the conventional in the design of the details for appliances to accomplish a given result by a new method, the newness of the method generally consisting of some radical change in one detail of the previous method, without the introduction of other changes that might be advantageously made, owing to the modified conditions introduced by the main improvement. The object in question was a self-propelled water-wagon, which was apparently made to resemble the one from which the horses were unhitched as nearly as the present state of the art of automobile construction would permit; and, to a casual observer noting the frantic efforts of the driver of the "watermobile" endeavoring to see ahead as well as to know what he was doing with the water, one absurdity in the design was very apparent; for, if there is any real good reason why a self-propelled water-wagon should not have the sprinkling apparatus in front, where it belongs, I would be pleased to know it? We all know that "the man on the water-wagon" needs our friendly aid and encouragement in his endeavors to look ahead, and forget the past, so here is a chance for the designer to aid materially in accomplishing this result. J. E. TERNAN.

Cutting Teeth in Pinion Wire.

In the manufacture of bicycle bells we had been using brass wire of toothed section. This was cut up in the automatic machine into pinions of the required length. We had considerable trouble with this wire, owing to a twist which developed in the cooling after it was drawn; this, of course, gave a tooth face which was out of square and which, in the case of long pinions, amounted to a serious irregularity. We tried many ways of overcoming this, but without effect. Finally we decided to cut the teeth into ordinary brass rod of round section, and for that purpose I rigged up the device shown in the sketches.

To an ordinary lathe-bed *A*, Fig. 1, we fitted a screw *B*, which ran along the center, about 1½ inches below the surface. This screw was fitted with an ordinary planer-reversing gear *C*, and was driven from a countershaft. At either end of the lathe bed we placed a tailstock D, which could be securely fastened in position by means of handle *E*. Running through each tailstock was a spindle which could be advanced or retired by means of a screw, and was fitted at one end with a chuck *F*, and at the other with an index plate *G*, the latter being controlled by lever *H*. Free to move along the lathe bed when fed by screw *B*, was a gray-iron slide *I*, bolted to which was the bush bracket *J* and the cutter-spindle bearing *K*, the object of *J* being to provide a traveling steady-rest immediately behind the cutter, as shown in Fig. 2. Firmly bolted to the lathe-bed, one at each end, were the gray-iron brackets *L* and L^1, which carried, in the one case, the driving pulley *M* and the narrow rawhide belt pulley *N*, and in the other case, the narrow pulley N^1 only. Running over the pulleys *N* and N^1, and completely around *O*, was a ⅝-inch rawhide belt. By this driving scheme the bracket carrying the pulley *O* was enabled to traverse the length of the lathe-bed while *O* was being driven. The face of this pulley was made concave in order to throw the belt toward either edge, and so prevent overlapping. The brass rod to be milled, which had previously been reduced for about 4 inches at each end to enable the cutter at the commencement of the operation, to assume the position shown in the sketch in Fig. 2, was passed through the bush plate and stretched between the tailstock by drawing back the spindles therein, after which the first cut was taken by throwing in both drives and traversing bracket *I* by means of screw *B*. When the end of the cutting stroke was reached the driving screw was automatically reversed by stop 2, and the cutter bracket returned ready for the second cut. This and the succeeding cuts were taken after attending to the index plates. C. F. H.

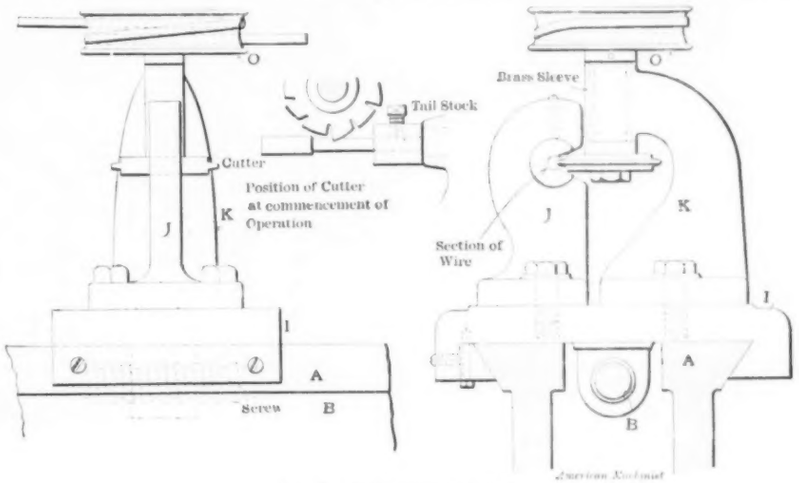


FIG. 2. THE CUTTER SLIDE.

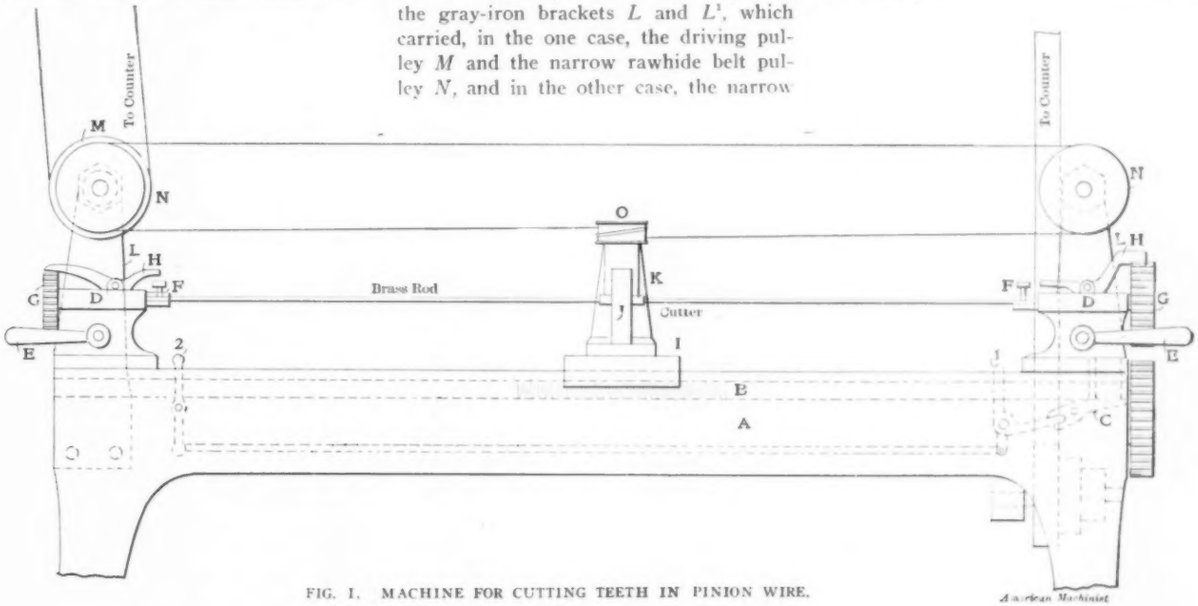


FIG. 1. MACHINE FOR CUTTING TEETH IN PINION WIRE.

Knots.

In supporting a swinging scaffold, it is is often advantageous to use light material, while at the same time, strength is required. A plank on edge is a great deal stiffer than the same plank laid flat,

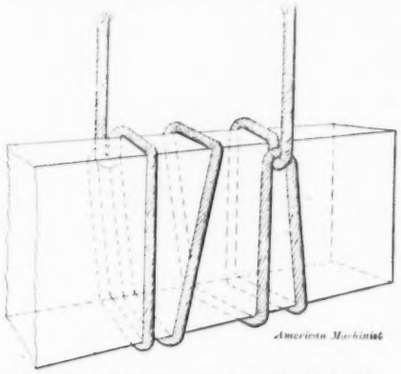


FIG. 1. SLINGING A PLANK ON EDGE FOR SCAFFOLDING.

and Fig. 1 shows how to sling a plank edgewise by a rope so that it will stay. The knot used is a very simple one. A clove hitch is made around the end of the plank; then one of the parts is twisted around the plank until the ends lead as shown in the sketch.

Very often it is desirable to shorten a piece of rope without cutting it. Fig. 2 shows a sheep's shank which is used for this purpose. The rope is brought back on itself, making two or more bights, and a half hitch is taken around each bight. This knot will not slip, and will nearly fall apart of its own accord if the strain is released, so that when there is a liability of this happening, it is well to pass a piece of wood through the loop *A* at each end and pull the rope tight on them.

One of the handiest knots to know is a bowline. The method of tying a simple bowline is illustrated in Kent's Pocket-

FIG. 4. THE RIGHT WAY TO RIG A TACKLE.

book, in the section devoted to knots. The bowline will not slip, and is easy to untie. It can also be tied in the bight of a rope, and is then called a "bowline in a bight." The steps required to tie it are shown at Fig. 3. It is particularly handy when it is necessary to hitch an auxiliary tackle on a fall to get additional purchase for a heavy lift. This knot has all the good points of the simple bowline.

In using a block and fall for pulling

FIG. 2. SHEEP'S SHANK FOR TAKING UP SLACK.

things, there is a right way and a wrong way of doing it. Fig. 4 shows the right way, *W* being the weight to be moved. If *A* were the weight and *W* the post, the blocks being left as shown, then it would be wrong. The advantage of the right way of doing it is that the leverage due to one additional part of rope in the tackle is gained! thus a three-part fall, rigged in the right way, is as good as a four-part fall rigged in the wrong way, and has the additional advantage that there is one less sheave with its friction. In lifting a heavy weight, it is sometimes desirable to put a tackle on the fall to gain additional leverage; the common practice in a case of this kind is to hitch the auxiliary tackle to a "dead man." The right way is to hitch this tackle to the piece to be lifted alongside the main tackle, which adds considerably to the leverage, being equivalent to one more part to the main fall besides the gain by the use of the auxiliary fall.

A. D. WILLIAMS, JR.

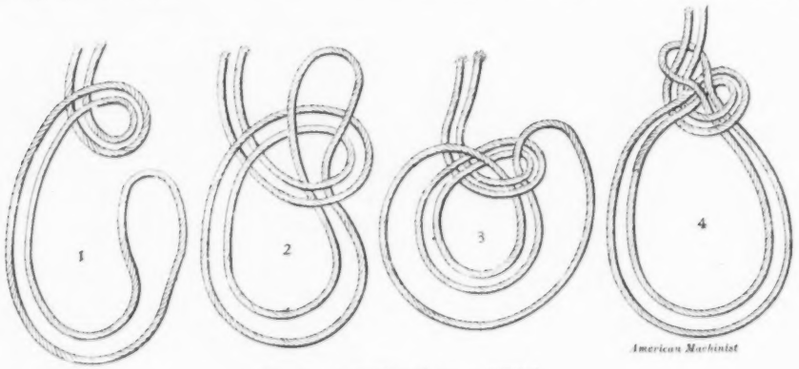


FIG. 3. A BOWLINE IN A BIGHT.

Making a Hub-Forming Tool.

A customer of mine, possessed of more gold than gray matter, thought he could make a fortune by putting in a bicycle hub machine. In due time the machine was installed, and—as I did all his other work in the way of toolmaking—a large order for tools was sent to me.

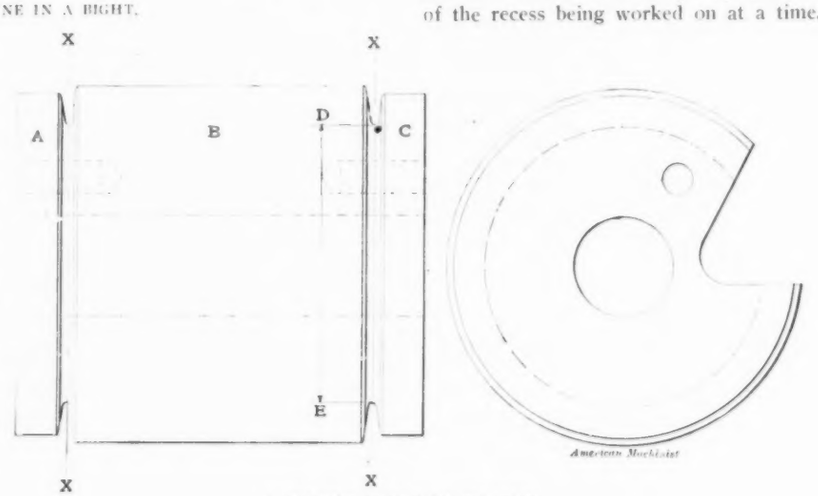
My knowledge of making hub tools, or in fact screw-machine tools of any sort, was at that time very meager.

The first hub-forming tool was made of one piece of steel. Of the hours it took to cut those two little grooves, and the language used, the less said the better.

I am a truthful man and so will not venture a guess at how many times the tool broke in the groove, or how many times—being unable to remove the broken end of the tool from the groove—I was compelled to re-anneal the whole business. "But experience teaches fools"—I mentally included myself in that class for having taken the job—so I hit upon the plan of making the tools in three pieces, as shown in the illustration, the dividing lines being at *X*.

The three pieces *A*, *B* and *C* were bored, reamed and rough turned. The ends of the pieces *A*, *B* and *C* were then faced, the pieces put together on a mandrel and the dowel-pin holes drilled and reamed. Two washers were then made of machinery steel ¼-inch face—each with a hole in the center fitting the mandrel and one also for the dowel pin—the diameter of the washers being *D E*. The whole business was then put on a mandrel with the machinery-steel washers between *A B* and *B C*.

The washers being ¼-inch face permitted a heavy tool to be used in the recesses and a nice smooth job resulted. No tools were broken, as there was no chance for the tool to bind, only one side of the recess being worked on at a time.



A BICYCLE HUB-FORMING TOOL.

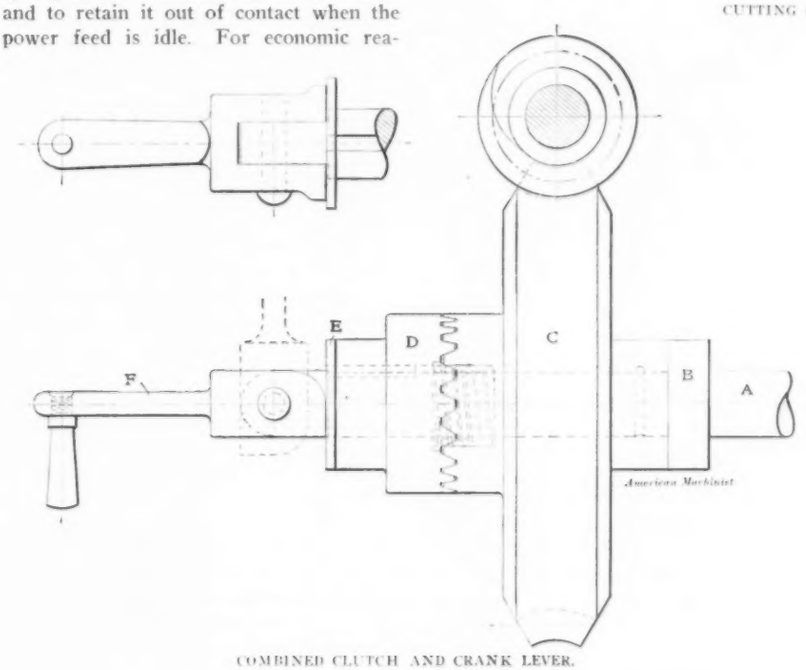
A further development of this process resulting in a saving of time and better product, was used on the next and subsequent hub-forming tools. The center holes were bored and reamed in the pieces

first. The pieces were then turned to shape all over, allowing about .005 for grinding on the ends only of the piece *B*—the diameter of the tool being immaterial. The dowel holes were drilled and reamed, and the pieces hardened. Then each piece was separately ground to size and shape and the whole tool assembled. Doing the job in this way took about the same time that it did to bore and rough turn the one-piece tool. The risk of loss in tempering was considerably less. Any one of the pieces could be easily replaced, and what was of most importance, the finished hubs were all that could be desired.

DIXIE.

Combined Clutch and Crank Lever.

The special type of clutch herewith illustrated forms a feature of an automatic machine recently designed by me. It is simple in construction, is positive and practically instantaneous in its action. In this case it is used in connection with a worm gear *C*, which runs free on the shaft *A*, against a thrust collar *D*. The clutch teeth are radial, V-shaped and of the same angle and section as the Seller's thread, to avoid binding and afford instant release when the crank handle is raised. Recesses or pockets are counterbored in the clutch *D* and in the worm gear, into which is fitted a steel spiral spring to assist in throwing out the clutch and to retain it out of contact when the power feed is idle. For economic reasons, the steel washer *E* is used to take the wear, which otherwise would fall on the clutch *D*. The eccentricity of the cam portion of the lever *F* is, of course, in direct proportion to the depth of the clutch teeth, plus 1-16 inch for clearance. The outer end of shaft *A* is milled flat on two sides, and drilled to form an eye for the forked end of the crank lever.



COMBINED CLUTCH AND CRANK LEVER.

As may be observed, the clutch lever is designed for use as a crank with which to turn the shaft *A* by hand. The washer and those portions of the lever subject to wear are case-hardened.

JAMES PATTISON.

Cutting Clutch Teeth With one Setting.

Some time ago I had a large number of clutches to make with teeth like those shown in Fig. 1. As we wanted to get them out as cheaply and as quickly as possible, we hit on the following method of doing the job:

The blanks were first roughed out, bored, counterbored, and reamed, then driven on a mandrel and finished. When cutting the teeth, the spiral head was turned up to 90 degrees and the finished blank was held in the chuck. We took a stock cutter, set the inside edge on the center line of the finished blank and took a cut clear across the face of the blank, as shown at *A*, Fig. 2. It will be noticed that the number of teeth was odd, in this case 7, but any odd number of teeth can be cut by this method. Next we indexed 1-7 of a circle and took another cut clear across the face the same as with the first cut. When we had taken four cuts the blanks looked like Fig. 3. Indexing three more times completed the clutch teeth by removing the stock at *A A A* and *B B B*, Fig. 3.

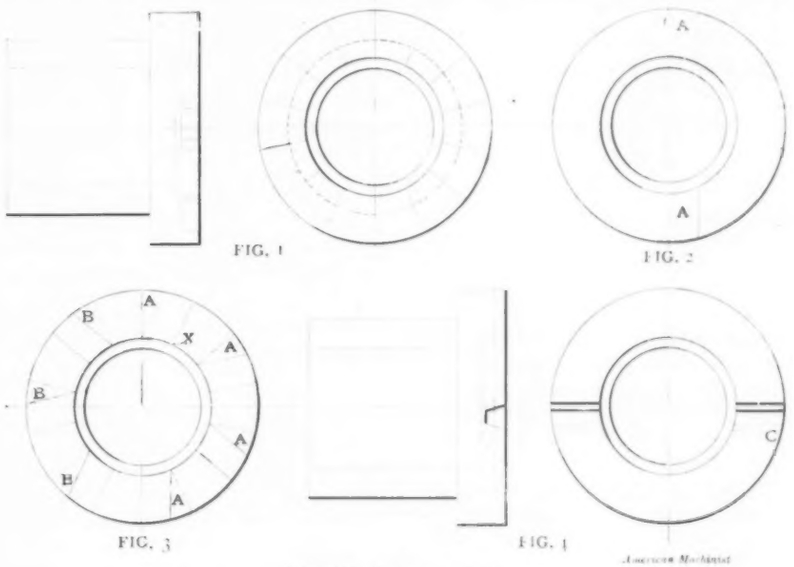


FIG. 1 FIG. 2 FIG. 3 FIG. 4

CUTTING CLUTCH TEETH.

While the width of the cutter can be calculated it is quicker and easier to lay the teeth out and determine the width of cutter by scaling the drawing. The width can be any convenient width, so long as the cutter clears the point *X* and is still wide enough to remove the stock at *A*, Fig. 3.

Fig. 4 is another style of clutch tooth that can be cut by this method, the only difference being that the cutter used is a rack cutter. The operations are exactly the same as for the first style. In designing clutches to be cut in this way, the teeth must in all cases be an odd number, and the ratio of the inside to the outside diameter must not be under 6 to 10. Clutches made by this method worked well in practice, each tooth having a good bearing with a minimum amount of backlash and pulling out easily under pressure.

If a clutch is desired that can be run in either direction with no backlash, one with teeth like Fig. 4 is desirable, but instead of setting the cutter so that the center line is half the depth of the cut, set the cutter so that the center line will be only four-tenths of the depth of the cut from the top of the tooth, giving a clearance at the bottom of the teeth of one-fifth of the depth of the cut. These clutches can always be driven up tight, but should always be held from slipping out.

W. H. A.

Factors of Pi.

I am sorry again to obtrude my views. Mr. Pearce's error lies, it seems to me, in this, that he makes the difference 25 in 100,000,000, whereas it is 25 in 314,159,265, or 1 in 12,566,370. But I do not see why he should have added another decimal figure to the value of π. My figures ended as soon as there was a divergence in the two values, and were sufficiently accurate for the purpose in view. According to Mr. Pearce's figures corrected as above, the difference between $\frac{355}{113}$ and π is nearly 1 inch in 200 miles.

WM. COX.

The fraction $\frac{113}{355}$ for the factor Pi which was treated in a recent issue of the AMERICAN MACHINIST, can very readily be kept in store in our upper story for occasional use by applying the following mnemonic rule:

Put down the three first uneven numbers 1, 3, 5, in pairs, thus 113355, then put the three first figures in the numerator, the three last ones in the denominator.

E. W. Z.

Making Things Work.

"A Device that was a failure," at page 506, calls to mind an important incident which happened in connection with some work I had in charge. My position being the opposite of Mr. Menegus', I cannot take issue with him, but can show how a supposed failure was made to work.

After conducting the experimental work which was successfully completed on some intricate mechanism, the next thing to do was to design tools for its manufacture. All went well until we commenced to use a device I had designed for milling a peculiar spiral groove which connected two straight grooves 51 degrees apart in a half cylinder. Then the trouble began. The man at the machine was breaking 3-16 inch end mills by the handful, and not doing any work. After quite a while he brought me one as finished. It was too bad to be used. I watched him while he did the next one—same result. Then we began to consider. I questioned the man as to what he thought of it, without getting any satisfaction. Determined to make the best of it, I tried one myself, and found it necessary to feed one way only, to prevent the mill "hogging in." The backlash in the feed had a tendency to cause the same trouble, and, moreover, I was well convinced the man was trying to "kill the job." After satisfying myself as to what could be done, I directed the man to put a spring on the fixture to take up motion on the spiral feed, and severely admonished him by saying:

"This device has been made expressly to mill these pieces; it is the best and only means we have of doing them; the work is delayed waiting for this piece. We have got to do them this way, and there will be trouble if we don't get some finished in a few days. I think it is 'up to you.' If you want me, come over to the desk."

Two days elapsed and no response; so I called on the man, and found he had been doing one an hour since I had last seen him.

This device has been in use for over two years, and is still doing good work; yet, at one time I was about ready to pronounce it a failure, and certainly would if I had taken the workman's verdict of it.

In the present day of mechanical progress, we all very well know that time should not be wasted, but "to prove all things, and hold fast that which is good," the mechanic's perseverance and resourcefulness go a long way. U. B. S.

Tool for Countersinking the Bottom of Hole—A Boring-Tool Holder.

Fig. 1 shows a teat drill used for a similar purpose as the one illustrated at page 289, Part 2, Vol. 28. The holes are

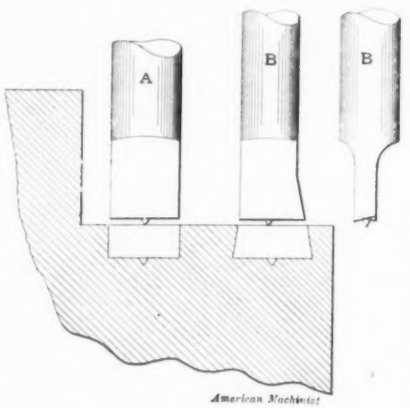


FIG. 1. COUNTERSINKING TOOL.

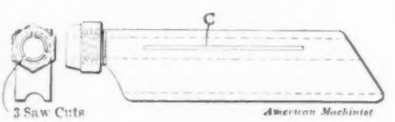


FIG. 2. A BORING-TOOL HOLDER.

first drilled with teat drill *A*. The extreme point of countersink *B* is made round and will not cut; therefore, as it enters the center made by the teat drill the cutting edge which is off center is forced to one side, making the hole as shown.

Fig. 2 shows a very handy boring-tool holder for small work. The boring tools are made out of 5-16 inch Crescent drill rod clamped in the holder by the hexagon nut. The set-screw in the tool-post also clamps the holder and tool over slot *A*. This tool should be carbonized and hardened, or if made of tool steel should be spring tempered. A. JACKSON.

The announcement is made that the Pennsylvania Railroad proposes to electrify one of its Atlantic City lines.

Fourth Annual Convention of the National Tool Builders' Association.

The fourth annual convention of this association was held at the Hoffman House, New York city, October 16 and 17, and all but a very few of the concerns enrolled in the organization were represented at the different sessions. There were no formal addresses and the business of the convention was practically concluded by noon of the second day.

DISCUSSIONS.

The Committee on Motor Drives, and the Committee on the Apprenticeship System made no final reports, but stated the complexity of the subjects and further consideration will be given these by the present committees.

Both topics came in for general discussion. In connection with the discussion of standardization of drives, the suggestion was made that it might be well to adopt a motor with 2 to 1 variation and minimum and maximum speeds of 500 and 1,000 revolutions per minute, respectively, each lathe builder to design his head gearing to suit; no definite action was taken, however, and a further report from the committee will be made at a later meeting.

REPORT OF THE DELEGATES ATTENDING THE NATIONAL RECIPROCITY CONFERENCE.

This report, made by the president, Wm. Lodge, and secretary P. E. Montanus, who attended the above conference at Chicago, August 16 and 17, expressed the appreciation of the delegates of the resolutions passed at that conference, advocating reciprocal tariff concessions, and stated that without doubt the National Tool Builders' Association would be asked by the permanent committee on organization to become a member of the Reciprocity Association.

PRICES OF MACHINE TOOLS.

The matter of prices is one left to subcommittees; and, while such matters are settled behind closed doors, it is learned that the lathe section will make no change at present. It is believed, however, that there is likely to be a general advance in miller prices, to help cover the increased cost of manufacture, due to improvements in construction incorporated since present prices were made. This matter, however, together with the question of planer prices, which are also likely to be advanced somewhat, will be settled later by the members of the sub-committees on millers and planers. The prices of certain millers have, however, been recently advanced by certain manufacturers independently of the association's action, and simply because conditions had become such that some millers were being made and sold at too close a margin for safe business, if not at a loss.

ELECTION OF OFFICERS.

The officers elected were as follows: President, E. M. Woodward, Woodward

& Powell Planer Company, Worcester, Mass.; first vice-president, William Lodge, Lodge & Shipley Machine Tool Company, Cincinnati, Ohio; second vice-president, W. P. Davis, W. P. Davis Machine Company, Rochester, N. Y.; secretary, P. E. Montanus, Springfield Machine Tool Company, Springfield, Ohio; treasurer, F. E. Reed, F. E. Reed Company, Worcester, Mass.

NEW MEMBERS.

The following firms were admitted to membership: Rivett Lathe Manufacturing Company, Brighton, Mass.; Hoefer Manufacturing Company, Freeport, Ill.; National Acme Manufacturing Company, Cleveland, Ohio; I. H. Johnson, Jr., Company, Philadelphia, Pa.; Chandler Planer Company, Ayer, Mass.

After the Monday morning session the association, visitors and press representatives were entertained at luncheon by the AMERICAN MACHINIST, and on Tuseday afternoon they were given an excursion by *Machinery*, which included a trip by steamboat to the Brooklyn Navy Yard and a sail from there around Manhattan Island. Luncheon was served on the steamer. The next meeting will be held at Atlantic City, at a date to be settled later.

THE BANQUET AND ADDRESSES.

Monday evening, at 7 o'clock, a banquet was given by the association to its members and a few invited guests. The banquet itself was an example of the best that the Hoffman House could produce, and at its close there were addresses by Fred J. Miller and Charles A. Moore. The former spoke (by request) of an association formed and operated for some years in Birmingham, in a certain line of the metal trade, which association, instead of attempting to control the prices of the products of its members, controls and sees to it that each member puts a price upon his goods which will afford him at least a minimum profit, which had been agreed upon and specified by the association, the cost to each manufacturer being determined by a standard method adopted by the association and agreed to by its charter and other members. The speaker pointed out that this form of association obviated many of the difficulties attending such associations as attempted to control prices, because it leaves the door open for competition, and each member is able to improve his product or to improve his method of manufacturing, and to get the benefit of such improvement the same as he may under free conditions of competition, with the added benefit that he has no unfair competition to meet; that is, competition based upon absence of profit, or losses, as is too often the case with business done at the present time. The plan also allowed the public to participate in the benefits of cost reduction and of product improvement, because decreased costs could result in decreased selling price, as though there were no organization. He recommended that the members of the association give this matter careful study, as the maintenance of reasonable profits was a subject evidently near the heart of every member of the association. This question of the cost of production led to the subject on which the speaker had prepared an address and in which he detailed some of the difficulties peculiar to Government manufacturing and some of the things which handicap military officers who carry on manufacturing; recommending that the manufacturing enterprises of the United States Government be carried on by a trained and experienced manufacturer, who, he believed, should have the title of Secretary of Manufactures, and should be a member of the President's cabinet.

Mr. Moore, who had recently returned from Europe, spoke on matters connected with the commercial end of the machine-tool business, advocating better packing for foreign shipments, better banking facilities for business abroad, and suggested a lot of things which, though they have been fully covered by numerous articles in our columns and were well understood by the large share of his hearers who have been exporting machine tools for years, were new to some of those present. He also challenged anyone to show wherein the Dingley tariff could be improved, and denounced as "theorists," or worse, all who thought it might be. After adjournment the speaker learned that there were present important manufacturers doing a large business abroad and well acquainted with business in Europe, who did not at all agree with him in this point.

REGISTER OF MEMBERS AND VISITORS.

William Lodge, Lodge & Shipley Machine Tool Company, Cincinnati, O.; P. E. Montanus, Springfield Machine Tool Company, Springfield, O.; F. E. Reed, F. E. Reed Company, Worcester, Mass.; E. M. Woodward, Woodward & Powell Planer Company, Worcester, Mass.; W. P. Davis, W. P. Davis Machine Company, Rochester, N. Y.; H. H. Klusman, Greaves, Klusman & Co., Cincinnati, O.; B. B. Quillen, Cincinnati Planer Company, Cincinnati, O.; A. M. Wachter, Queen City Machine Tool Company, Cincinnati, O.; L. E. Twachtman, Fosdick Machine Tool Company, Cincinnati, O.; W. T. S. Johnson, Bradford Machine Tool Company, Cincinnati, O.; Wm. H. Owen, Owen Machine Tool Company, Springfield, O.; J. S. Detrick, Detrick & Harvey Machine Company, Baltimore, Md.; Joseph Flather, Flather & Co., Inc., Nashua, N. H.; H. L. Flather, Flather & Co., Inc., Nashua, N. H.; O. M. Flather, Mark Flather Planer Company, Nashua, N. H.; J. B. Doan, American Tool Works Company, Cincinnati, O.; Rufus King, King Machine Tool Company, Cincinnati, O.; R. K. Le Blond, R. K. Le Blond Machine Tool Company, Cincinnati, O.; A. E. Newton, Prentice Brothers Company, Worcester, Mass.; Geo. O. Gridley, Windsor Machine Company, Windsor, Vt.; Geo. W. Fifield, G. W. Fifield, Lowell, Mass.; H. Binsse, Binsse Machine Company, Newark, N. J.; H. C. Hoefinghoff, Bickford Drill & Tool Company, Cincinnati, O.; Fred A. Geier, Cincinnati Milling Machine Company, Cincinnati, O.; F. W. Boye, Jr., Schumacher & Boye, Cincinnati, O.; C. F. Hilker, Hamilton Machine Tool Company, Hamilton, O.; C. H. Norton, Norton Grinding Company, Worcester, Mass.; B. F. Barnes, B. F. Barnes Company, Rockford, Ill.; C. J. Wetsel, Baush Machine Tool Company, Springfield, Mass.; Lewis H. Morgan, Ridgway Machine Tool Company, Ridgway, Pa.; Ulrich Eberhardt, Gould & Eberhardt, Newark, N. J.; C. E. Holgate, Gould & Eberhardt, Newark, N. J.; W. D. Woolson, Jones & Lamson Machine Company, Springfield, Vt.; Murray Shipley, Dietz Machine Tool Company, Cincinnati, O.; S. H. Bullard, Bullard Machine Tool Company, Bridgeport, Conn.; D. B. Bullard, Bullard Machine Tool Company, Bridgeport, Conn.; E. P. Bullard, Jr., Bullard Machine Tool Company, Bridgeport, Conn.; C. H. Alvord, Hendey Machine Company, Torrington, Conn.; W. S. Chase, National Acme Manufacturing Company, Cleveland, O.; Israel H. Johnson, Jr., I. H. Johnson, Jr., Company, Philadelphia, Pa.; Geo. J. Burns, Chandler Planer Company, Ayer, Mass.; H. E. Fisher, Chandler Planer Company, Ayer, Mass.; Henry B. Brown, H. B. Brown Company, East Hampton, Conn.; Geo. K. Garvin, Garvin Machine Company, New York City; E. Rivett, Rivett Lathe Manufacturing Company, Brighton, Mass.; John Anderson, Cleveland Automatic Machine Company, Cleveland, O.; H. M. Harding, Electro - Dynamic Company, Bayonne, N. J.; T. B. Peck, Jr., Electro-Dynamic Company, Bayonne, N. J.; G. N. Converse, Electro-Dynamic Company, Bayonne, N. J.

A Suggestion in a Box.

One of the delegates to the convention of the National Association of Machine-Tool Builders tells a story relating to the suggestion-box as used in many up-to-date manufacturing establishments. In this particular establishment the proprietor is thoroughly up to date, and is considerably devoted to the automobile. He has one in which he frequently comes to the factory, and, as is the way with automobilists, he often spends a good deal of time tinkering with it. So one of the audacious kids about the place bethought him of a valuable suggestion, and into the box went a slip on which it was suggested that it would be a good thing for the business if the "old man" would devote more of his time to the management of the works and the business connected with it, and less to tinkering with that automobile. The proprietor happened to be a man capable of appreciating a joke, even if it was on himself. The value of the suggestion was appraised at $10, and the boy got it.

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The Remuneration of Labor.

As we have before remarked, the subject of wages system is receiving much attention in Great Britain, and a large amount of very intelligent discussion of it has taken place there. Under the above title, a recent number of *Engineering* discusses the differential piece rate and the premium plans and to the disadvantage of the former, albeit the writer had before him a successful example of its application. After stating quite clearly Mr. Taylor's methods, our contemporary goes on to say of the differential piece-rate system:

"With it there seems no room in the same works for first-class and mediocre men, though the latter form by far the majority of the working classes, as of all other classes of the community. Indeed, Mr. Taylor, in his papers read before the American Society of Mechanical Engineers, to which we are indebted for the above details, insists on the importance of the object-lessons afforded by the dismissal of men for failure to perform their allotted daily task. With British works managers, at any rate, this concomitant of the system as outlined by Mr. Taylor would be extremely distasteful. The most distressing portion of a manager's duties arise when bad trade, or other reasons, necessitate a reduction in the staff. From his wife, who is often appealed to by the men's wives, or by the clergyman, he learns what takes place inside the dismissed man's front door when he brings back the fateful news which is to break up his home. After all, the mediocrities have a right to some consideration. It must doubtless add greatly to the pleasures of management to have none but the most capable workmen to deal with; but it can never be feasible to man all factories entirely with selected men."

Our contemporary is by no means the first to whom this humanitarian aspect of the matter has appealed. There is, however, another feature of Mr. Taylor's system which runs parallel with and must largely offset this objection. Not only does the plan presuppose a picked set of workmen, but it also presupposes a picked set of managers, and managers of unusual ability are relatively just as scarce as are workmen of similar ability.

We have never known a case in this country in which Mr. Taylor's ideas have been put into successful use except by himself or by those who have been associated with and largely trained by him. Indeed, if we understand him correctly, he would scarcely expect success with the plan except when installed by those who have already become experts in its use. Moreover, when thus installed, it has led to an initial outlay of time and money which to most managers would seem, if it actually were not, prohibitory. Under these circumstances, it seems to us abundantly clear that it cannot, in any large sense, be considered a solution of the wages problem. If it requires, as it does, the exceptional man to install it and even to seriously contemplate the initial outlay which it involves, it cannot find large application, nor can its shelving of the average workman go to serious lengths.

Ignoring entirely its humanitarian aspect, it is its simplicity and its applicability by the average manager that is the chief recommendation of the premium plan. It does not aim so high as to miss its mark entirely. It is simple, practical, obvious, and it has been everywhere applied by those whose entire preparatory knowledge was acquired from printed descriptions of it and of its workings, and, as a natural consequence of its simplicity, success with it has been the rule and not the exception. We believe, in fact, that with no other plan of paying for labor has the ratio of success to failure been so high. Looked at in any large way, this is the crucial test. As in all other industrial matters, the supreme test is the test of results. Just as with every industrial appliance, the prime requirement is that it shall do its work, that it shall go under average conditions and in the hands of average men, so the prime requirement with a labor-payment system is that it shall be adapted to average commercial conditions and be capable of installation and management by average men. A system that falls short of this may achieve an occasional and even phenomenal success; but in the solution of the wages problem it cannot become a large factor.

A New Gyroscope Theory.

The September number of *The Optical Instrument Monthly*, which has come to this office, contains an article on "The Gyroscope," by its editor, Edward P. Buffet, who has evolved certain propositions in mechanics which, to say the least, sound remarkable. For one thing, he questions the propriety of regarding all motion as relative, and suggests that the gyroscope might perhaps be employed for the determination of *absolute* motion. But further, he attempts to start another and more definite principle, that it requires more force to rotate a heated body than a cold one. This is inferred from the nature of the gyroscope, or rather of the simple flywheel, whose turning causes it to resist angular deviation of its axis, although it does not tend to counteract influences of pure translation. If we believe that the molecules of a heated body are in vibration, each would seem to act like a little flywheel and resist the deflection from its path that would be involved in any rotation, or angular movement, of the body. Nor would the several molecules apparently neutralize each other in the exercise of this property, but rather they would go to make up a harmonious total of inertia; the influence of each varying down to zero, of course, according to the angle of

its motion to the axis of rotation of the body.

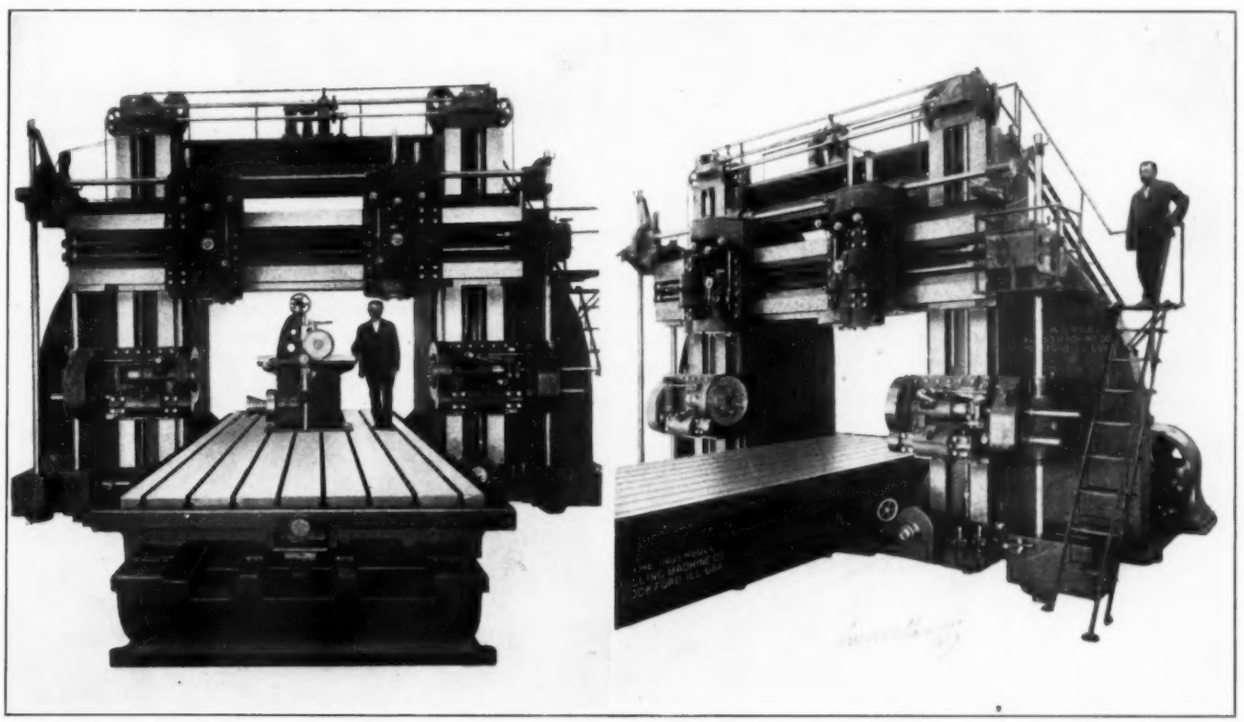
The advocate of the above theory has communicated to us directly a few words of further explanation. He points out that, in thinking about it, we must not confuse the original rotation of the flywheel, or the top, with the resisted rotation (or angular displacement) of the flywheel, top, or heated body. He contends that the analytical proof of the resistance of a revolving body to deviation as established by the parallelogram of forces (which is concisely stated under "Gyroscope" in the Century Dictionary) applies equally to any other motion, such as reciprocation or vibration. Thus, we do not have to suppose that the molecules are traveling in circular paths. The suggestion has been made to him by Walter Gribben, a valued contributor to the AMERICAN MACHINIST, that the correctness of this part of the theory might be practically tested by observation whether a pneumatic hammer, when in use, resists angular movements. Mr. Buffet remarks that the several molecules differ from the flywheel in the respect that each may be considered to be moving as a free body, and that this greatly complicates the problem, but probably does not affect its result. He is looking for someone to prick the bubble of the whole theory, but has not yet found anyone who has done so.

It would seem to be easy for some of our school shops to prove by an experiment whether or not it actually does require more force to rotate a heated body than a cold one.

New Tools and Machine Shop Appliances.

A HEAVY MILLING MACHINE.

We illustrate herewith a 10-foot, four-head milling machine recently furnished by the Ingersoll Milling Machine Company, Rockford, Ill., to the General Electric Company, Schenectady, N. Y. The view to the left, where a small miller is shown on the big platen, gives a good idea of the progress made in milling machine design at the Ingersoll shops since 1887—the date when they commenced the construction of this type of miller. The bed of this machine is 30 feet long and has four ways—two broad, flat ways at the outside and two narrower inner ones. All of them are provided with oil rollers to give plenty of lubrication to the table bearings. The table is 20 feet long between the pockets, 108 inches wide over all, and weighs 60,000 pounds. The housings are very wide and deep, and of the box girder type; and the counterbalanced cross-rail is raised and lowered by power. The saddles are all of the same type, and the cutter heads have face-plate drive. The vertical heads have independent adjustment vertically and the horizontal heads independent horizontal adjustment of 8 inches. The right-hand vertical and horizontal heads each carry auxiliary spindles for small face mills. Both vertical saddles have independent reversible cross feed, and the right-hand horizontal saddle has an independent up-and-down feed. Both horizontal saddles are raised and lowered by power and counterbalanced. The table feed is entirely independent from any of the other mechanism, being driven by a 15 horse-power variable-speed motor, with about two to one variation. There are eight changes of positive feed for every motor change. In all there are four motors for operating the machine: one 50 horse-power for driving the two horizontal heads, one 50 horse-power for the two vertical heads, one 15 horse-power for the table feed, and one 5 horse-power for raising and lowering the crossrail. All of these are General Electric variable-speed motors. The auxiliary housings are put up to support the main housings when the vertical spindles are taking a cross feed, especially if the crossrail is at a high point on the housings. The shipping weight of this machine was 300,000 pounds.



A HEAVY MILLING MACHINE.

A DOUBLE ROTARY SLOTTING MACHINE.

A machine tool of a new type, for slotting connecting rods, open end links crankshafts and similar work, is shown in the accompanying illustrations. It was made by the High Duty Saw & Tool Company, of Eddystone, Pa., for the Paterson, N. J., plant of the American Locomotive Company. Primarily it is intended to slot out open-ended locomotive connecting rods, straps for the same, the jaws of eccentric rods and crossheads. Sketches of some of the classes of slotting work done on the machine are shown in outline, in Figs. 3, 4 and 5.

As will be seen, the principle of the machine is that of a continuous cut in place of the intermittent stroke of the ordinary

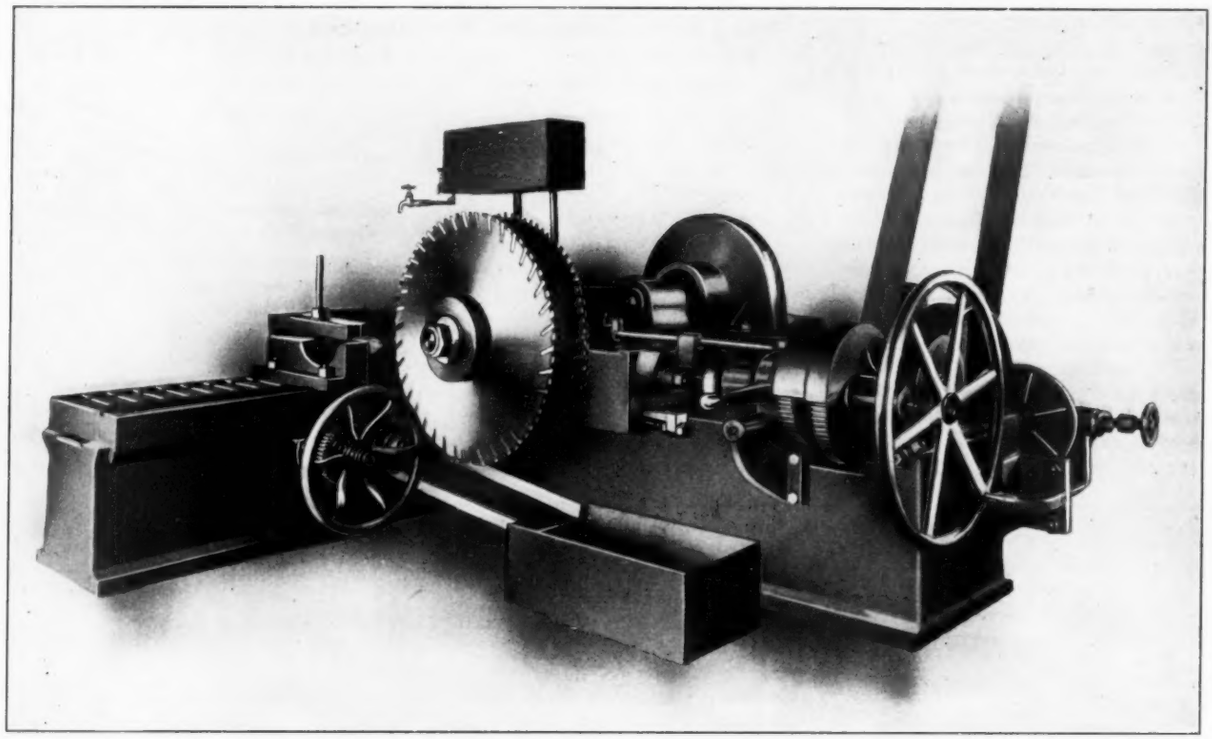


FIG. 1. FRONT VIEW OF DOUBLE ROTARY SLOTTING MACHINE.

slotting machines. The rotary milling machine action is made use of in place of the straight line action of the standard slotting machine. The loss of time by the return stroke of the slotting tool is eliminated and a steady unintermittent cut is substituted. The machine is equipped with two "Tindel" high-duty inserted-tooth saw blades 36 inches diameter, $\frac{3}{8}$

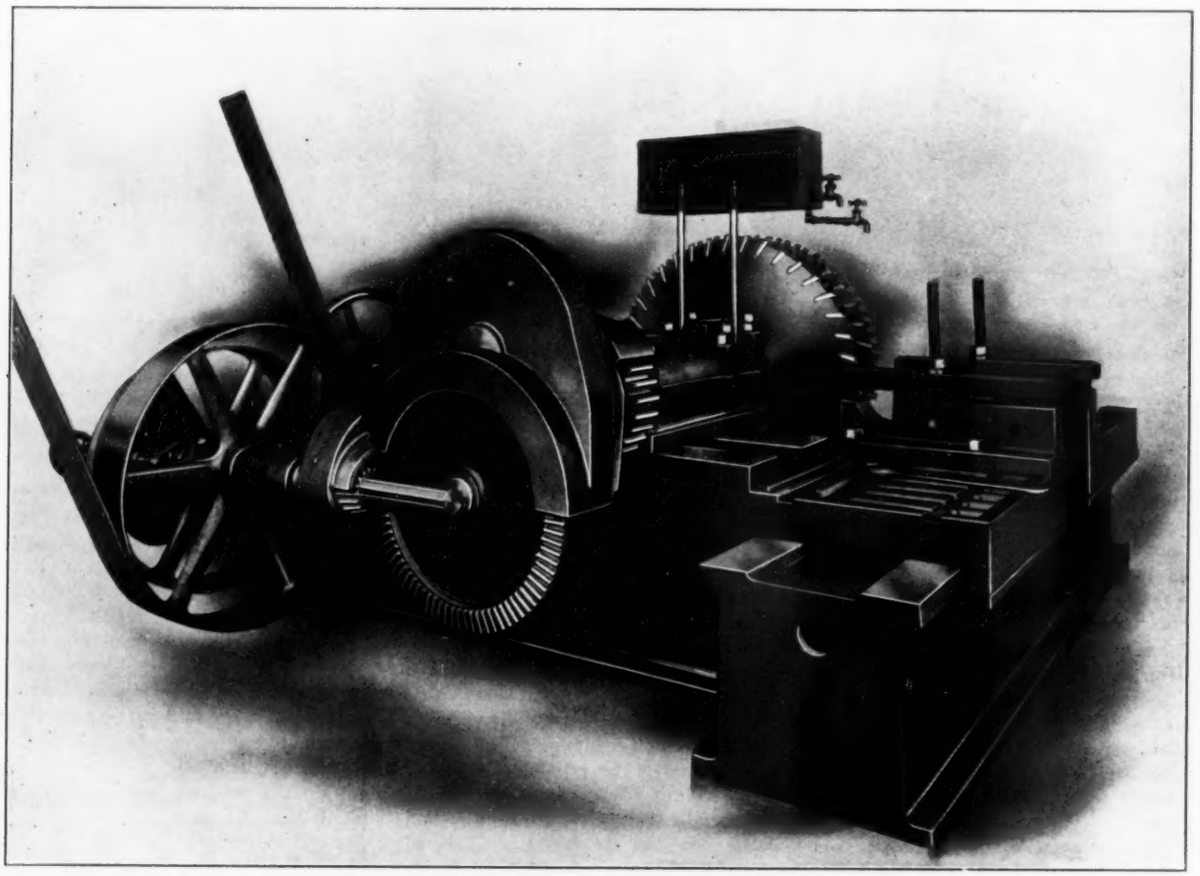


FIG. 2. BACK VIEW OF DOUBLE ROTARY SLOTTING MACHINE.

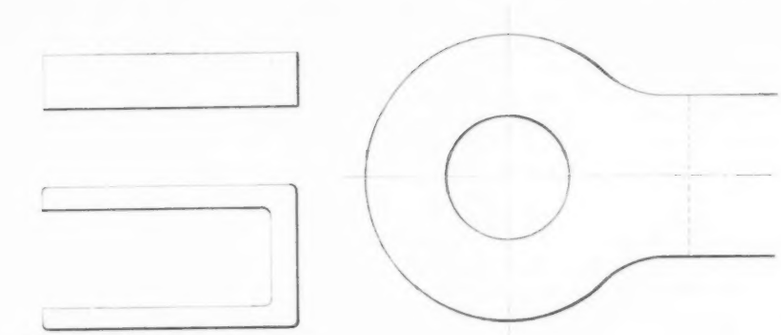


FIG. 3 Connecting Rod Stub End Strap

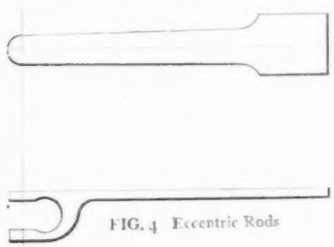


FIG. 4 Eccentric Rods

FIG. 5 End of Connecting Rod

EXAMPLES OF WORK SLOTTED ON THE DOUBLE ROTARY SLOTTING MACHINE.

inch thick with 76 teeth, or cutters, in each blade. The machine is solidly constructed for heavy work. The main drive, as is clear in Fig. 2, is by spur and bevel gears instead of the usual worm and worm wheel, the latter not being used because of its using up too much power in friction. The carriage carrying the saw arbor is square locked in front and tapered on back side, all wear being taken up with heavy phosphor bronze shoes. The arbor is a .60 carbon steel forging of large diameter and long bearing. The feed is by rolling friction disks. An automatic, adjustable and positive throw-out is an adjunct to the feed.

Washers are provided of varying calculated thickness, by the insertion of which the saw blades can be separated to any width up to 8 inches, and a corresponding slot obtained. This width of slot covers the requirements of locomotive work, but can be increased to meet any requirement.

The machine is equipped with two tables which are adjustable to work separately or together. By means of gearing below the tables any setting of work to the line can be done by a hand-wheel movement shown in front view of the machine, Fig. 1. The tables are furnished with "V" blocks, straps and bolt for convenient fastening of the work. By the use of this machine, slotting work of the character indicated can be accomplished with a saving of time amounting to 75 per cent. as against the ordinary type of slotting machine.

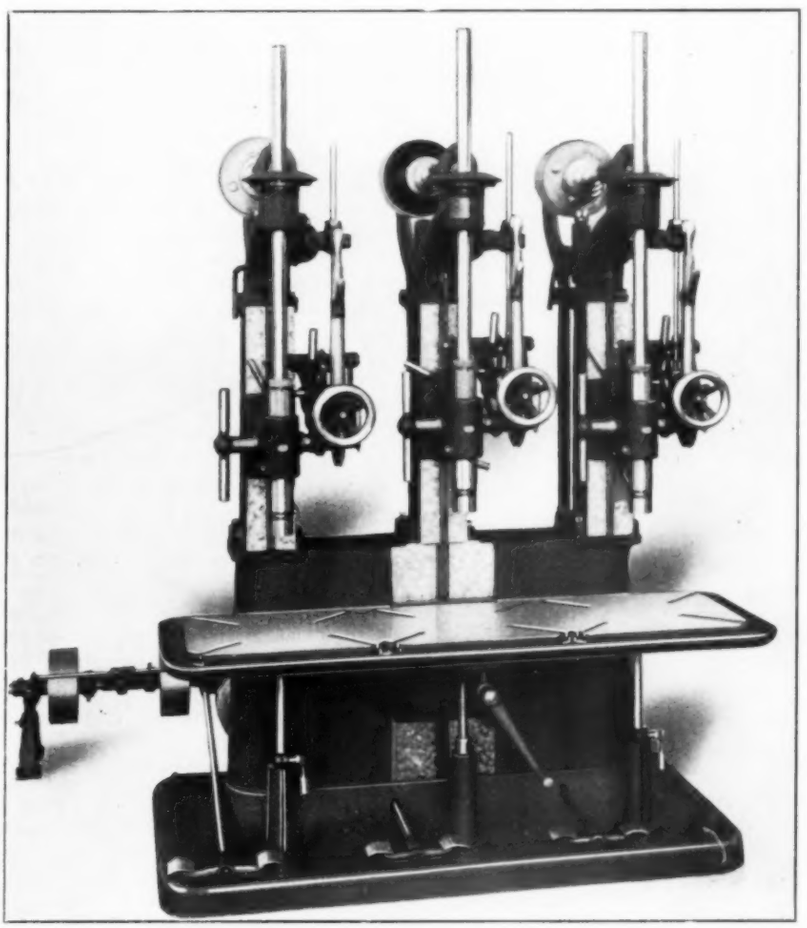
23-INCH SLIDING-HEAD GANG DRILL.

The machine illustrated herewith is a 23-inch sliding-head gang drill, which is furnished with two, three or four spindles. The sliding heads have 18 inches of vertical travel. The spindles, which have holes for No. 3 Morse taper, have a vertical travel of 12 inches; each one is driven from its own countershaft by a quarter-turn belt, thus making its speed and feed independent of all the others. The distance between centers of adjacent spindles is 20 inches.

Any or all of the spindles can be furnished with either a plain lever, or a wheel and lever feed, or, in addition to the latter, a power feed and automatic stop. Back gears can be supplied or not, as desired. Either or both of the outside spindles may be provided with a reversing friction countershaft for tapping, like that shown in the illustration for the spindle at the left end.

The width of the planed surface of the table is 16 inches, and its length for two, three or four spindles is 40, 60 and 80 inches, respectively. Its vertical travel is 14 inches, and its greatest distance from the spindle is 33 inches. The machine can be equipped with oil pump when desired.

The drill is built by the B. F. Barnes Company, Rockford, Ill.



23-INCH SLIDING-HEAD GANG DRILL.

New Publications.

"Notes for Mechanical Drawing." By Frank E. Mathewson. 86 9x6-inch pages, with many illustrations. The Taylor-Holden Company, Springfield, Mass.

These notes are the result of many years of experience in teaching drawing at the Mechanic Arts High School and the Evening School of Trades at Springfield. They are not intended as a text-book, but as a collection of notes, exercises and problems

to be used with such explanation or demonstration as the teacher may judge necessary.

"A Course in Tinting." By W. D. Browning. 14 6x9-inch pages, with 4 colored and 6 uncolored plates and 7 text cuts. The Browning Press, Cleveland, Ohio. Price, 50 cents.

This short course in tinting gives instructions in stretching paper, preparing washes, blending and shading.

"The University of Colorado Journal of Engineering." No. 1. 84 6x9-inch pages. Illustrated. University of Colorado, Boulder, Colorado. Price, 50 cents.

This new student publication contains some very creditable articles. As it is to be published but once a year, it should maintain a good standard.

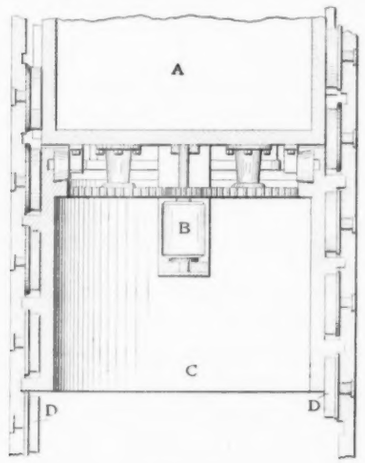
"Proceedings of the National Reciprocity Conference, held in the Illinois Theatre, Chicago, August 16-17, 1905." 124 6x9-inch pages. The National Committee of the Reciprocal Tariff League, Chicago.

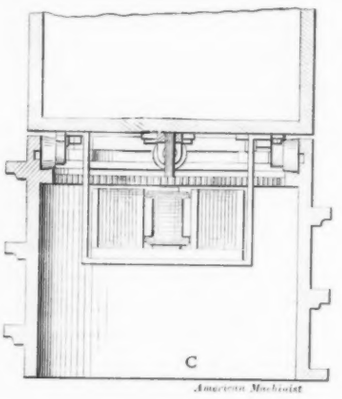
This pamphlet gives the addresses, discussions and resolutions of the reciprocity conference of which so much has been said, and of which the immediate results promise to be so small. However, this is part of the educational work that must always precede action by a people for its own good, and that work is progressing satisfactorily.

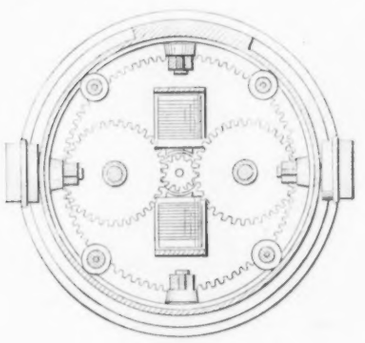
Electric Elevators.

The accompanying line drawing illustrates an elevator of novel construction, the car carrying its own operating motor, which is geared to a worm drum engaging with rolls or wheels supported by uprights at either side, thus giving a smooth and safe lifting action.

In the engraving, *A* is the car, *B* the motor, *C* the drum with a worm thread about its periphery, *D* two vertical series of rolls with which the drum thread engages to actuate the car. The driving gear, it will be noticed, is mounted directly on the motor shaft and intermediate gears transmit motion to the drum under the car through an internal gear formed inside the drum. The car has vertical guides attached at each side to engage the periph-







ELECTRIC ELEVATOR.

eries of the rolls and so keep it in alinement and also prevent it from turning with the drum, and the weight of the car is taken by roller bearings mounted in an annular recess at the top of the drum. As a safeguard against accident should one or more of the studs for the wheels or rolls *D* be broken, the thread of the drum is formed with a rib which extends into grooves cut in the uprights; thus the latter in emergency will support the drum and car directly.

One of these elevators, recently installed for sidewalk service in New York city, is equipped with an operating worm having a lead of 8 inches, and driven by a 2 horsepower motor, the speed of the worm being 30 turns per minute and the velocity of the car 20 feet per minute.

The builder of this elevator is the Standard Metal Strap Co., 336 East Thirty-eighth street, New York city.

The Pratt & Whitney Company in Canada.

It is announced that the Pratt & Whitney Company has purchased a plant in Dundas, Ontario, for the manufacture of their full line of small tools—taps, reamers, milling cutters, punches, dies, etc.

The building is a modern structure, and the power plant is already in place. The machinery equipment is being gotten ready at Hartford and will be sent there and operations begun immediately. The plant, we are informed, will also include a department for manufacturing a full line of twist drills, an elaborate equipment of special machinery having been gotten ready for the purpose.

The location of the factory is near that of the John Bertram & Sons Company which, as has been announced, was recently purchased by the Niles-Bement-Pond Company.

Reception and Banquet to Officers of the Union Twist Drill Company.

On the evening of October 10 the Athol Merchants' Association, of Athol, Massachusetts, gave a complimentary banquet to the officers of the Union Twist Drill Company, which proved to be a very enjoyable affair. From 8 to 9 o'clock there was an informal reception, which was followed by the banquet at the Pequoig House. At the close of the feasting, President Charles A. Thomas of the Merchants' Association welcomed the new citizens of Athol, assuring them that their choice of Athol as a location was appreciated and that there would be every possible co-operation upon the part of its citizens to make the new enterprise a success.

E. T. Ward, treasurer of the company, was then called upon, and appropriately responded on behalf of the company. He was followed by John A. McGregor, president of the Union Twist Drill Company, who gave some account of what the company had done so far and what it expected to do in the immediate future; he spoke in the highest terms of the mechanical skill to be obtained in New England, said that there had been such a great increase in the cutter business that it had inevitably delayed preparation for the manufacture of twist drills, and that 74 people were now employed, instead of the 47 which were employed when the new company took hold of the business. Mr. McGregor expressed his belief that there was every reason to expect a development of the new enterprise similar to that which had taken place in the establishment with which he had been connected for the past ten years in New Bedford. He also referred to Athol's lack of houses in which workmen could live. He thought that if twenty good houses were now started, such houses as would rent from $12 to $18 or $20 a month, they would all be taken before they were completed. The lack of houses was one of the greatest drawbacks he had observed in Athol, and it might be necessary for the firm to employ single men, or men who came from out of town, because others would at present have no place in which to live. Messrs. McSkimmon and Drury also spoke as representatives of the Union Twist Drill Company.

TABLE A

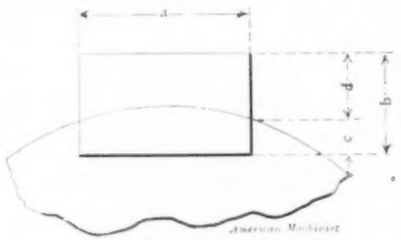
Diameter of Shaft	Key
15/16 – 1 1/8	1/4
1 3/16 – 1 3/8	5/16
1 7/16 – 1 7/8	3/8
1 15/16 – 2 3/8	1/2
2 7/16 – 2 7/8	9/16
2 15/16 – 3 3/8	11/16
3 7/16 – 3 7/8	13/16
3 15/16 – 4 7/8	15/16
4 15/16 – 5 7/8	1 1/16
5 15/16 – 6 7/8	1 5/16
6 15/16 – 7 7/8	1 7/16
7 15/16 – 8 7/8	1 11/16
8 15/16 – 9 7/8	1 15/16
9 15/16 – 10 7/8	2 1/16
10 15/16 – 12 7/16	2 1/4
12 1/2 – 14 7/16	2 1/2
14 1/2 – 15 15/16	2 3/4
16 – 17 15/16	3
18 – 19 15/16	3 1/4
20 – 21 15/16	3 1/2
22 – 23 15/16	3 3/4
24 – 25 15/16	4 1/2
26 – 27 15/16	4 1/2
28 – 29 15/16	4 3/4
30 – 31 15/16	5
32 – 33 15/16	5 3/8
34 – 35 15/16	5 5/8

Thickness of key at the large end is the same as the width

(Note. Table A was taken from the Walker Co., Catalogue.)

TABLE B

Shaft Diameter	a	b	c	d
15/16	3/8	1/4	3/32	5/32
1 3/16	7/16	9/32	3/32	3/16
1 7/16	1/2	5/16	3/32	7/32
1 11/16	9/16	11/32	1/8	7/32
1 15/16	5/8	3/8	1/8	1/4
2 3/16	11/16	13/32	5/32	1/4
2 7/16	3/4	7/16	5/32	9/32
2 11/16	13/16	1/2	5/32	9/32
2 15/16	7/8	1/2	3/16	5/16
3 3/16	15/16	1/2	3/16	5/16
3 7/16	1	9/16	3/16	3/8
3 11/16	1 1/16	9/16	3/16	3/8
3 15/16	1 1/8	5/8	7/32	13/32
4 3/16	1 3/16	5/8	7/32	13/32
4 7/16	1 1/4	11/16	1/4	7/16
4 11/16	1 5/16	11/16	1/4	7/16
4 15/16	1 3/8	3/4	1/4	1/2
5 3/16	1 7/16	3/4	1/4	1/2
5 7/16	1 1/2	13/16	9/32	17/32
5 11/16	1 9/16	13/16	9/32	17/32
5 15/16	1 5/8	7/8	9/32	19/32
6 3/16	1 11/16	7/8	9/32	19/32
6 7/16	1 1/4	15/16	5/16	5/8
6 11/16	1 13/16	15/16	5/16	5/8
6 15/16	1 7/8	1	5/16	11/16
7 3/16	1 15/16	1	5/16	11/16
7 7/16	2	1 1/16	5/16	3/4
7 11/16	2 1/16	1 1/16	5/16	3/4
7 15/16	2 1/8	1 1/8	3/8	3/4



TAPER 1/8 INCH PER FOOT.

TABLE C

Shaft Diameter	a	b	c	d	e	f	g
1 1/4	5/16	5/16	1 7/8	5/32	7/16	5/64	1/8
1 1/2	3/8	3/8	2 1/4	3/16	1/2	3/32	1/8
1 3/4	7/16	7/16	2 5/8	7/32	9/16	7/64	3/16
2	1/2	1/2	3	1/4	5/8	1/8	3/16
2 1/4	9/16	1/2	3 3/8	1/4	5/8	1/8	3/16
2 1/2	5/8	1/2	3 3/4	1/4	5/8	1/8	1/4
3	3/4	5/8	4 1/2	5/16	3/4	5/32	1/4
3 1/2	7/8	5/8	5 1/4	5/16	3/4	5/32	1/4
4 1/4	1	3/4	6 3/8	3/8	7/8	3/16	1/4
5 1/4	1 1/4	15/16	7 7/8	15/32	1 1/16	15/64	1/4
6 1/2	1 1/2	1 1/8	9 3/4	9/16	1 1/4	9/32	5/16
7 1/2	1 3/4	1 5/16	11 1/4	21/32	1 7/16	21/64	3/8
8 1/2	2	1 1/2	12 3/4	3/4	1 5/8	3/8	3/8
9 1/2	2 1/4	1 3/4	14 1/4	7/8	1 7/8	7/16	1/2

a = Width of key.
c = Maximum length of key. When length of hub is shorter than dimension c, length of key = length of hub.
d = 0.5 b = depth of key in hub or shaft
For intermediate sizes of shafts use next larger size.
Only one width of key in a shaft.
Taper 1/8 inch per foot.

At end of shaft length of Keyway = c or length of hub + g.
Key not at end of shaft, length of keyway = c + e.

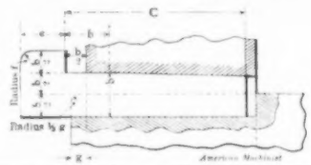


TABLE D

Shaft Diameter	Key Width	Key Thickness	Depth in Shaft	Depth in Hub
3/4 – 15/16	5/16	1/4	1/8	1/8
1 – 1 3/16	3/8	5/16	3/32	5/32
1 1/4 – 1 9/16	7/16	3/8	3/32	7/32
1 5/8 – 1 15/16	1/2	7/16	3/16	1/4
2 – 2 7/16	5/8	1/2	7/32	9/32
2 1/2 – 3 3/16	11/16	9/16	1/4	5/16
3 1/4 – 3 15/16	7/8	21/32	11/32	3/16
4 – 4 15/16	1 1/16	13/16	13/32	13/32
5 – 6 7/16	1 5/16	1	1/2	1/2
6 1/2 – 8	1 5/8	1 1/4	5/8	5/8

Taper 3/16 inch per foot.
Thickness of key measured at head.

TABLE OF DIFFERENT STANDARDS OF KEY DIMENSIONS.

The Design of Keys.

BY A. D. WILLIAMS, JR.

It would be interesting to know how many different "standard" key tables are in use in the different engineering works in this country for the purpose of securing couplings and wheels from turning on their shafts. The size of the key is usually based entirely upon the size of the shaft, though occasionally two and in some rare cases three keys are used, in place of a single large one.

The writer has at hand tables giving the sizes of keys used by several firms, who will be designated A, B, C and D. Table A covers shafting from 15-16 inch to 35 15-16 inches in diameter; 27 different sizes of keys are used, from 1/4 inch to 5 5/8 inches square at the large end, no mention being made as to the length of the key used.

Table B covers shafting from 15-16 to 7 15-16 inches in diameter; 29 different sizes of keys are used ranging from 3/8x 1/4 to 2 1/16x1 1/8 inches in width and thickness. These keys are tapered 1/8 inch per foot, but the length to be used is not given.

Table C covers shafting from 1 1/4 to 9 1/2 inches in diameter, 14 sizes of keys being used, from 5-16x5-16 to 2 1/4x1 3/4 inches in width and thickness; the maximum length of key to be used is approximately 1 1/2 times the diameter of the shaft and only one size of key is to be used in one shaft. These keys are tapered 1/8 inch per foot.

Table D covers shafting from 3/4 to 8 inches in diameter, 10 sizes of keys being used, ranging in size from 5-16x1/4 to 1 5/8 x1 1/4 inches in width and thickness, the taper being 3-16 inch per foot. This table is used by several different firms.

From the above samples it can be seen

that there is some diversity in practice in regard to the size of keys to be employed, and in only one case is the limiting length of the key specified. Robert S. Riley, at page 247 of the first part of the current volume of the AMERICAN MACHINIST, presented a very interesting paper on "Key Design" and made out a very clear case in favor of a rational method of proportioning keys, and similar arguments can be applied with equal force to the desirability of using rational methods in the design of standard machine parts. After a firm has adopted a certain standard key table and built a number of machines in which these standards have been employed, it is difficult to make any alteration in them without causing a lot of trouble and confusion, the confusion being confined to their own shop, but the trouble occurs also with those who purchase repair parts from them and have to chip keyways and fit new keys, and afterward they make an expurgated report of the fact to the people who changed their standard.

Occasionally trouble occurs by reason of the key shearing, but this is a rare occurrence. The shearing or crushing usually occurs in the hub of the wheel, and it is generally crushing that occurs; for this reason a great many concerns put one-third of the key in the shaft and the balance in the hub of the wheel, giving the wheel the greater share of the bearing surface, as it is in most cases an iron casting and the shaft of steel. The side fit of the key is very important and it is also important that it should fit top and bottom, and the purpose of tapering keys is to secure a top and bottom fit by driving them home, the keyway in the hub of the wheel having a corresponding taper.

Mr. Riley cites a case where a gear wheel was split by a badly fitted key. Keyways are usually made square cornered and therefore present a favorable condition for a crack to start, and a great many wheels are spoiled in the course of a year by reason of their hubs cracking outward from the corner of the keyway; this trouble is so common that in many cases the hubs are reinforced at this point. A method of reinforcing the hub for this purpose was recently described in the AMERICAN MACHINIST. The writer knows of several cases in which badly fitted keys have been crushed and at the same time so crushed the hub of the wheel that it was impossible to force the key out or remove the shaft, hydraulic jacks only producing a local upsetting of the material. In one case the gear and shaft being heavy, the key was large enough to permit of drilling a 3-inch hole through it and it was then split out by means of an electric arc. This operation was assisted by the gear being located on an enlarged portion of the shaft; in getting this shaft ready for a new gear a second keyseat was cut in it. This gear, like the one mentioned by Mr. Riley, was subjected to rapid reverse stresses, being used to drive a two-high blooming mill.

One disadvantage of numerous sizes of keys occurs when for reasons of design it is desirable to have the shaft of different diameters at various points; if the tabular sizes of keys are used, two or more different widths and depths of keyway will have to be cut, necessitating several settings of the machine and changes of cutters. This condition is not at all unusual, but it will be noticed that it is only provided for in the case of Table C.

A German newspaper states that the new main railroad station at Leipzig, now being constructed, will be the largest in the world, as regards covered area, the area being 920,518 square feet. It will have 26 tracks. The first place is now occupied by the St. Louis Union Station (32 tracks); next come the South Station in Boston (28 tracks), the St. Lazare at Paris, then the stations at Frankfort-on-Main, Dresden, the North Station at Boston, Cologne and Munich. We might add that the Union Station now being built in Washington will have 33 tracks, but that there will be no big train shed, "umbrella sheds" over the platforms being used instead.

We thought that the Poleforcia momentum engine, like the Keeley motor, was extinct. It would seem, however, from a letter which B. C. Pole has addressed to *The Times*, of London, that the "marvelous" performances of the momentum engine still excite the astonishment of the inventor. According to the communication quoted, 18 indicated horsepower was put into the apparatus, while 27 indicated horse-power came out of it—truly, as Mr. Pole observes, "a most astonishing result," and one which, it is dryly observed, is only exceeded by the persistency with which Mr. Pole advances the claims of the delusion represented by his engine, and, we might add, the credulity with which some people will probably accept it.—*The Mechanical Engineer.*

According to the *U. S. Government Advertiser*, the new magazine rifle for the army will be ready for issue to the service in April. It is doubtful if the small-arm can be completed in sufficient quantities to enable the army ordnance officers to send out the piece to troops much before that time. The delay, of course, is caused by the changes which have been made as a result of recent investigations in the Far East and the reports of army officers who have served as military observers with the warring armies in Manchuria. These changes include the adoption of the new type of bayonet.

The Civic Federation Review.

Among the features of the October issue of the *National Civic Federation Review* are an article extolling the successful mediation of the President of the United States between Russia and Japan, as illustrative of the advantage of wider employment of similar methods of conciliation in adjusting industrial conflicts; an address by William J. Bryan, delivered at Omaha on Labor Day, treating of the duties to the community and to itself of organized labor; a symposium of articles by national labor leaders upon the significance and the proper celebration of Labor Day; a description of how a system, termed "Mutual Government," has met with practical success in attaining peaceful relations between the capital invested and the labor employed in an important industry; an account of methods of price regulation in commercial organizations, employing methods to prevent destructive competition similar to methods employed by unions against some wage-cutting; an analysis of exaggerations and misstatements contained in recent "smash-the-unions" literature; a correct report of a typical speech by John Mitchell before anthracite miners, about whose attitude there has been much misapprehension; a review of the absurdities of some recent Socialist literature; and a comprehensive illustrated article by H. H. Vreeland, president of the New York City Railway Company, describing "Welfare Work in the United States."

Telephone linemen, working in the vicinity of Cheyenne, Wyoming, tell of a remarkable phenomenon seen during a recent electrical storm, and on several other occasions the past summer. During the storms the toll lines were put out of commission, and gangs of linemen were sent out to repair the damage. In one place, for a distance of several poles, they discovered that the thick wire had vanished entirely, the only evidence of its previous existence being a green streak along the ground between the poles. The lightning bolts had struck the wire and melted it so completely that not even a trace of the metal could be discovered. During every electrical storm this season the toll lines have been struck by lightning and rendered useless until they could be repaired. During June there were fourteen electrical storms, and during July eighteen, so that the woes of the telephone companies in Wyoming can be readily understood. Not only has communication over one telephone line been destroyed, but frequently in half a dozen places.

Personal.

William C. Redfield, of J. H. Williams & Co., Brooklyn, N. Y., manufacturers of drop forgings, has been elected a director of the Equitable Life Assurance Society, New York.

The fastest and most sumptuously equipped ocean steamships in the world are now built in Germany. There will shortly be placed in the trans-Atlantic service two vessels which will surpass in every respect the "Great Eastern," which was one of the world's marvels, and only failed to meet expectations because technical science in 1859 was not what it is to-day. These vessels have been ordered by the Hamburg-American Line, the one being built by the firm of Harland & Wolff, at Belfast; the other by the Vulcan Works, at Bredow, near Stettin. The one being built at Belfast has 22,250 gross tons, is 690 feet long, 74 feet wide and 53 feet deep, with 15,800 horse-power. The one being built near Stettin has 25,000 gross tons, is 700 feet long, 77 feet wide and 54 feet deep, with 17,200 horse-power.

Business Items.

At a directors' meeting of the Crocker-Wheeler Company, manufacturers and electrical engineers, Ampere, N. J., the regular quarterly dividend of 1¼ per cent. was declared.

We have illustrated and described in our columns the detachable chain made by the Whitney Manufacturing Company, for use on automobiles. This concern is now making a repair outfit for this chain, consisting essentially of a device which can be carried in the tool box of an automobile, and which has two punches or drift-pins, which, when worked by a lever, force the rivets out of the detachable links and at the same time hold the chain in proper position.

Manufacturers.

Chas. S. Parsons, Beverly, N. J., expects to erect a new tool factory.

The Cadillac (Mich.) Crate Company, will locate a plant in Paris, Tex.

The chain works of J. B. Carr & Co., Troy, N. Y., was destroyed by fire.

The Ohio Lock, Nut & Bolt Company, Lancaster, O., will erect a plant.

The National Bed Company, Moundsville, W. Va., will erect a new plant.

The Keeler Brass Company, Grand Rapids, Mich., will erect a new factory.

The Cumberland (Md.) Glass Company will move its plant to Fairmont, W. Va.

The Howe Scale Company, Rutland, Vt., will put up an addition to its plant.

The Pittsburg (Pa.) Motor Vehicle Company will erect an automobile factory.

Plans are prepared for a new packing-house for James Henry, Seattle, Wash.

James La Taurette will move his smelter plant from Marion, Ind., to Tulsa, I. T.

J. H. Eldridge, Carrolton, Ga., will establish a trunk factory in Anniston, Ala.

Emil Calman & Co., New York, manufacturing varnishes, are erecting a new plant.

The Morris Machine Works, Baldwinsville, N. Y., is putting up a new machine shop.

The National Soap Manufacturing Company, Philadelphia, Pa., will erect a new factory.

The Forest City Paint & Varnish Company, Cleveland, O., will erect a $29,000 factory.

A. & M. Levy, New York, will erect a large silk ribbon manufactory in Mt. Carmel, Pa.

The St. Paul (Minn.) Showcase Manufacturing Company will erect a $3,000 addition.

A new factory site has been purchased by the Northway Motor Company, Detroit, Mich.

The Clipper Lawn Mower Company, Dixon, Ill., will probably move its plant to Moline, Ill.

The Lamb Fence Company, of Adrian, Mich., will establish a factory in Great Britain.

The A. Schoenhut Company, Philadelphia, Pa., will build a five-story addition to its factory.

The Texas Gas Company has been granted a franchise for a gas plant at Brownwood, Texas.

A. Wolf, Chambersburg, Pa., will build a large factory for the making of concrete blocks.

The J. A. Sloan Grocery Company, Columbia, Tenn., will erect a warehouse, to cost $7,000.

The Dealers' Steam Packing Company, Palmyra, N. Y., is erecting a new factory building.

The Illinois Automobile & Parts Company, Peoria, Ill., has commenced erection of new buildings.

A $100,000 cotton mill is to be established at Statesville, N. C., by J. C. Smith, of Newton, N. C.

The Reliance Textile & Dye Works, of Covington, Ky., is looking for a location in Cincinnati, O.

The Acme Cement Plaster Company, of St. Louis, Mo., is erecting a plant in Grand Rapids, Mich.

Oppenheim, Oberndorf & Co., shirt manufacturers, Baltimore, Md., will erect a six-story factory.

The Locke Insulator Manufacturing Company, Victor, N. Y., is erecting another plant, to cost $40,000.

The Northwestern Mantel Company, Minneapolis, Minn., has commenced the erection of its new plant.

B. N. Moore & Sons, Peabody, Mass., manufacturers of morocco, will enlarge the capacity of their plant.

A five-story factory will be erected for A. Cutler & Sons, Buffalo, N. Y., manufacturers of office desks, etc.

C. L. Steffens & Co., manufacturing saddlery hardware, Newark, N. J., is erecting a new $10,000 plant.

The Rust Boiler Company, Pittsburg, Pa., will erect a new plant, to be equipped with the latest machinery.

The Columbus (O.) Packing Company is erecting a new plant to replace the one burned some time ago.

One of the mills of the Lydall & Foulds Paper Company, Manchester, Conn., was burned; loss, $20,000.

The Central Railroad of New Jersey has passed plans for a $500,000 storage warehouse in Newark, N. J.

Bantleon Brothers Company, Rochester, N. Y., has filed plans for a new $30,000 sash, door and blind factory.

The American Pin Company is planning to erect another big factory building at its Waterville, Conn., plant.

Lewis Elmer & Sons, Baltimore, Md., are erecting a new plant for the output of their cider, vinegar, yeast, etc.

The Bangor House, Bangor, Me., will erect a $20,000 addition, which will include a cold-storage plant and kitchen.

F. Blumenthal & Co., morocco manufacturers, Wilmington, Del., will build a new six-story addition to its plant.

The United States Reduction & Refining Company, of Denver, Colo., will erect a cyanide plant at Colorado City.

The Hayes Manufacturing Company, maker of parts of automobiles, Detroit, Mich., has bought a new factory site.

Contract has been let for an addition to the fitting department of the Anniston (Ala.) Foundry & Machine Works.

The Mountain Ice Company, Pueblo, Colo., whose plant was burned a short time ago, is rebuilding on a larger scale.

The Veneer Barrel Company, of Pittsburg, Pa., is looking for a site in Wheeling, W. Va., to establish a branch factory.

The plant of the Kleinsmith Brass Foundry & Nickelplating Works, Brooklyn, N. Y., was destroyed by fire; loss, $10,000.

The Union Soda Water Company, St. Louis, Mo., has filed application for a permit to erect a factory to cost $25,000.

The Amoskeag Manufacturing Company will erect another big mill in Manchester, N. H., for making its cotton goods.

Fire destroyed the cooperage plant of Goepper Brothers, Cambridge, Mass., entailing a loss of $60,000. It will be rebuilt.

The Compton Shear Works, Newark, N. J., will erect a new grinding and forging building, and a new engine-room will be added.

The Moline Foundry Company, of Moline, Ill., has been incorporated. John R. Weeks, Peter J. Kail, S. S. Hoffman, incorporators.

A two-story factory and warehouse will be built for the Mullen Manufacturing Company, Baltimore, Md., maker of bolts, blocks, etc.

The Sedro-Woolley (Wash.) Excelsior & Veneer Company will install machinery for the manufacture of chair bottoms and chair backs.

The Menominee (Mich.) Electrical & Mechanical Works, whose plant was burned some time ago, will rebuild on a much larger scale.

It is reported that James Ackroyd & Sons, Albany, N. Y., may erect a factory for the manufacture of cornices and other plumbers' supplies.

The cotton mill of the Dan River Power & Manufacturing Company, at Danville, N. C., will be doubled, at an expense of about $1,000,000.

The Utica (N. Y.) Steam & Mohawk Valley Cotton Mills are building an addition to the mill proper, and additions to the engine and boiler-rooms.

Gustave Steinhardt, leather manufacturer, Newark, N. J., has had plans drawn for a new factory. There will be separate boiler- and engine-houses.

A $500,000 bloom and ingot foundry is to be constructed for the rail department of the National Tube Company at Lorain, O., also two blast furnaces.

The R. M. Cornwell Company, Syracuse, N. Y., is looking for a factory or site for the purpose of manufacturing on a larger scale its gasolene engines.

Plans are maturing for the construction of a $200,000 beet sugar refinery near Ouray, Colo. Wm. F. McNee, of Ouray, is at the head of the enterprise.

The Lagonda Manufacturing Company, Springfield, O., has secured a site, and will erect a new factory to manufacture its boiler-tube cleaners and other devices.

John Dunfee, Syracuse, N. Y., has been awarded contract for the erection of a $265,000 brewery in Schenectady, N. Y., for the Mohawk Valley Brewery Company.

It is reported that the Proctor & Gamble Company, of Cincinnati, O., manufacturing soap, etc., has acquired land on Staten Island, N. Y., on which a large plant will be erected.

The Cambria Steel Company, Philadelphia, Pa., will double the capacity of its forge plant. Among the new machinery to be installed will be a 1,000 horse-power hydraulic press.

The Addyston, O., plant of the United States Cast Iron & Pipe Company will, it is said, be enlarged at an expense of $200,000, and a new plant to cost $500,000 will be erected in the Birmingham district.

The Standard Manufacturing Company, Council Bluffs, Iowa, will enlarge its plant, one new building to be erected for the exclusive manufacture of shovel boards and another to be used as a warehouse.

It is reported that Chas. Duryea, of the Duryea Power Company, Reading, Pa., is interested in a company to be capitalized at $200,000, and which will erect an automobile factory in Washington Courthouse, O.

A large brick-making plant will be located near New Brunswick, N. J., in which W. B. Parsons, the engineer for the New York subway; St. John Clark, the engineer for the Long Island tunnel, and others are interested.

New Catalogs.

R. D. Nuttall Company, Pittsburg, Pa. Pretty illustrated pamphlet showing parts of the plant and its product.

Williamsport Gas Engine Company, Williamsport, Pa. Catalogue describing gas and gasoline engines made by this company. Illustrated. 6x9, pp. 17, paper.

Westinghouse Electric & Manufacturing Company, Pittsburg, Pa. Circular No. 1119, September, 1905, illustrating and describing motor-generators. 7x10, pp. 11, paper.

The Ingersoll-Sergeant Drill Company, 11 Broadway, New York. Bulletin No. 2002, from the Pneumatic Tool Department, illustrating and describing stone-working tools. 6x9, pp. 16, paper.

American Blower Company, Detroit, Mich. Catalogue No. 186, describing "A B C" heating apparatus. Illustrated. 7x9, pp. 31, paper. Also Pamphlet No. 185, in regard to the economy of "A B C" Type "A" engine, and specification sheets covering same.

National Foundry Manufacturing & Supply Company, Williamsport, Pa. Illustrated catalogue and price list of power-transmission appliances made by this company, including a full line of shafting, pulleys, hangers, floor stands, pillow blocks, couplings, etc. 3½x6, pp. 36, paper.

Valley Iron Works, Williamsport, Pa. No. 1, Vol. 1, of the Lycoming Bulletin, being the first edition of a bulletin to be issued by this company describing the Lycoming engine. This number contains quite a detailed description of the mechanism of the engine and half-tone illustrations.

Miscellaneous Wants.

Advertisements will be inserted under this head at 25 cents a line each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Caliper cat. free. E. G. Smith, Columbia, Pa.

Punches & dies. Wal.M.Wks.,Waltham,Mass.

Will buy or pay royalty for good patented machine or tool. Box 282, AMER. MACH.

Light and fine mach'y to order; models and elec. work specialty. E. O. Chase, Newark, N. J.

Wanted—Patented specialties of merit to manufacture and market. Power Specialty Co., 500 Washington ave., Detroit, Mich.

Make us your factory.
Specialties and machinery built to order. Close work; close prices. "Moderate," AM. M.

Work wanted for a Cleveland automatic lathe; handles 2 in. and under. The Earle Gear & Machine Co., 141 Oxford st., Philadelphia.

Established firm wants additional metal articles, tools or machines to manufacture; will buy desirable business, patent or idea. Address Box 139, AMERICAN MACHINIST.

Clock work and intricate mechanical instruments; meter counters, water, gas or electric; recording devices; special movements to order. D. S. Plumb, 57 E. Park st., Newark, N. J.

Tool Catalogue No. 22. 950 pages, bound in cloth. Greatest small-tool catalogue ever published. Will be sent post-paid on receipt of $1. Money paid for catalogue refunded with first purchase amounting to $10 or over. Book costs you nothing if you become a customer. Montgomery & Co., 109 Fulton st., New York City.

For Sale.

For Sale—9 in. foot-power lathe, compound rest and small tools. R. F. Clark, East Norwalk, Conn.

For Sale—A full line of mine and boiler feed pump drawings; a good specialty; latest and best designs. Box 757, AMER. MACH.

Business Opportunities.

I want a tool and die maker with money and good specialties, or even good ideas, to join me in manufacturing. I have both cash and specialties, and can market the product. "B. F. B.," 1020 Westinghouse Bldg., Pittsburg, Pa.

I have a marine specialty needed by every yacht and vessel. Already advertised and orders for over $1,000, yielding large net profits, actually in hand. No competition. Want partner with $5,000 to $10,000 to establish plant and manufacture. Only bona fide answers will be acknowledged. Box 700, AMER. MACH.

For Sale—A well-established, paying, metal-working plant in important manufacturing center; superior shipping facilities; equipped with best up-to-date machinery; good, substantial, well-lighted brick building and perfect site. Large orders in hand. Price $75,000 complete, or would sell large interest to good business man or capable, active shop superintendent. Reason for selling, advanced age and ill health of proprietor. Full particulars to interested parties on application. Address "Opportunity," care AMERICAN MACHINIST.

Wants.

Situation and Help Advertisements only inserted under this head. Rate 25 cents a line for each insertion. About six words make a line. No advertisements under two lines accepted, and no advertisements abbreviated. The cash and copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded; but replies will not be returned. If not forwarded they will be destroyed without notice. Original letters of recommendation or other papers of value should not be enclosed to unknown correspondents. Only bona fide situation want or help want advertisements inserted under this heading.. Agency advertisements must be placed under Miscellaneous Wants.

Situations Wanted.

Classification indicates present address of advertiser, nothing else.

INDIANA.

Superintendent; age 35; practical machinist; natural ability and wide experience, handling men and reducing costs. Box 713, A. M.

MICHIGAN.

Technical graduate, capable man, with 10 years' drafting-room and machine-shop experience, desires position as draftsman or assistant superintendent. Box 766, AM. M.

Mechanical and electrical engineer, expert in forge shop and furnace construction, technical graduate, 6 years' general engineering experience, desires a change. Box 714, A. M.

MINNESOTA.

Superintendent wants postion; New England man, age 39; good manager; a hustler; systematic; good mechanic and up in foundry practice; good references. Box 749, AM. M.

NEW JERSEY.

Wanted—Position as general foreman of machine shop; engine work preferred; first-class references. Box 742, AMER. MACH.

Draftsman; technical graduate; experienced designer; good toomaker on jigs, fixtures; 4 years shop foreman. Box 765, A. M.

A competent mechanical engineer seeks a position as chief draftsman and superintendent with a progressive concern, to design and manufacture a line of engines, pumps, hydraulic machinery or complete power plants. Address "Thorough," care AMER. MACHINIST.

NEW YORK.

Draftsman, up to date, seeks position. Box 736, AMERICAN MACHINIST.

Mechanical draftsman, machine shop experience, desires position. Box 738, AM. M.

Mechnical draftsman, graduate, with several years' experience, open for engagement. Box 751, AMERICAN MACHINIST.

Superintendent wishes to correspond with parties wishing up-to-date, live man; A1 record and references. Box 746, AM. MACH.

Pay master and machinery cost clerk, 4 years' experience on pay rolls, open for engagements; good reference. Box 758, AM. MACH.

Position by expert operator on semi-auto. turret lathe; will take charge or demonstrate; can devise tool equipment. Box 702, AM. M.

Position as chief draftsman or designer; 15 years' experience on high-grade machinery; thorough and practical knowledge of tool designing. Box 754, AMERICAN MACHINIST.

A1 draftsman, good machinery designer, 8 years' experience, technical college graduate, wishes to change; steady job with reliable concern; references. Box 755, AM. MACH.

Machine shop foreman, age 31, experienced in modern production and management high-grade duplicate and general machinery, desires responsible position. Box 752, AM. M.

Wanted—Position as works manager or superintendent of machine tool or engine work; several years' up-to-date experience; location immaterial. Answer Box 745, AM. M.

Position as superintendent or general foreman of machine shop; experienced and competent man, now holding position of responsibility; good reason for seeking change; will go anywhere; references. Box 721, AM. M.

Wanted—Position as foreman of toolroom or assistant superintendent, by experienced toolmaker; large experience on jigs and fixtures in the United States, England and Germany; at present employed as toolmaker and instructor on jigs and fixtures; age 39; good habits; open for engagement Nov. 6. Address "Hustler," care AMERICAN MACHINIST.

PENNSYLVANIA.

Drafting instructor; thoroughly experienced in practical and theoretical machine design; graduate of engineering course in technical school. Box 712, AMERICAN MACHINIST.

Superintendent, with executive ability and experienced in modern metal manufacture; toolmaker, with technical education; highest references from present employers. Box 724, AMERICAN MACHINIST.

WEST OF MISSISSIPPI.

Position wanted as superintendent of machine works, by first-class mechanic; have held similar positions past 13 years. Address J. L. Oefinger, Hotel Belvedere, Denver, Colo.

Help Wanted.

Classification indicates present address of advertiser, nothing else.

ILLINOIS.

A large structural steel manufacturing concern in Chicago invites applications from thoroughly competent men, for position of general foreman in their shop; applicants, to receive consideration, should state fully their experience, references and present place of employment; no applications are desired from men who do not consider themselves competent to secure the highest salaries paid for this class of service. Box 744, AM. MACH.

INDIANA.

Wanted—An assistant to chief draftsman in large automobile factory; must be well recommended and give age, salary, experience, where last employed. Box 741, AM. M.

MASSACHUSETTS.

Wanted—Diemakers on small work. Apply to J. W. Lindley, American Optical Co., Southbridge, Mass.

Wanted—Experienced operators on Fellows gear shaper, Gleason planer, Jones & Lamson and turret screw machines. Boston Gear Works, Boston, Mass.

Man of experience in similar work, to organize and maintain an employment bureau in connection with our works. B. F. Sturtevant Co., Hyde Park, Mass.

Foreman, with successful experience in complete charge, planning work and handling help, manufacturing small, accurate metal parts from sheet metal and rods by blanking presses, screw and tapping machines, drill presses, etc.; state experience in detail and names of employers for past 3 years, which will be considered confidential; wages $18 to $25; chance for promotion; location, Boston. Box 743, AMERICAN MACHINIST.

MICHIGAN.

Wanted—Man with technical training and shop and drafting-room experience, to teach shop drafting and machine tool design; do not apply unless familiar with modern shop methods; full particulars required; $1,200 annually for 9 months' work. Box 720, A. M.

MINNESOTA.

Wanted—First-class tool and die makers, capable of doing small, accurate work. Address, with references, G. F. Kriesel, Minneapolis, Minn.

NEW HAMPSHIRE.

Brass molder who understands melting, to take charge of small brass foundry; give references and pay expected. Box 701, A. M.

Wanted—Good, husting foundryman, to take contract to run my foundry, employing from 12 to 20 men, by the pound, or will lease foundry and buy castings at fair price; foundry new and well equipped. Address Box 756, AMERICAN MACHINIST.

NEW JERSEY.

Two first-class mechanical draftsmen wanted at once; state experience and salary expected. Box 762, AMERICAN MACHINIST.

Lathe, planer and boring mill operators wanted for night shift; those accustomed to machine tool work preferred; steady work and good pay to good men. Address the Pond Machine Tool Co., Plainfield, N. J.

Wanted—An up-to-date foreman in a machine shop doing general work; a person with some knowledge of paper-making machinery preferred; state age, experience and references. Box 764, AMERICAN MACHINIST.

Wanted—Foreman; experienced man to take charge of brass shop, manufacturing valves, fittings and plumbers' specialties; give full particulars as to age, experience, salary last received, etc. Box 717, AM. M.

Wanted—Several first-class diemakers on high-grade work; sub-press diemakers preferred; steady work and good wages for good workmen; no labor trouble. Sloan & Chace Mfg. Co., 297 Washington st., Newark, N. J.

Diesinker.—Wanted—Competent man for making heavy drop-forge dies; steady work; factory located near New York; applicants will please state where they have been employed and character of work they have done. Box 739, AMERICAN MACHINIST.

NEW YORK.

Wanted—Mechanical draftsman; state age, experience, salary expected and give references. Box 760, AMERICAN MACHINIST.

Automatic screw machine operators; must be first class. Apply to The Western Electric Co., 748 Washington st., New York city.

Milling-machine hands, with experience on tool work; must be first class. Apply to The Western Electric Co., 748 Washington st., New York city.

A1 machinist on general line of lithographic presses; must thoroughly understand printing machinery; good wages; steady employment. Box 747, AMERICAN MACHINIST.

Wanted—Competent foreman for machine shop employing 35 men; state age, nationality, experience, compensation expected and where last employed. Box 763. AM. MACH.

Machinists for floor work; must be first-class men who will appreciate steady employment; open shop; 9 hours per day; wages $2.50. Address Box 708, AMER. MACHINIST.

Wanted—Several A1 mechanical draftsmen; only those having had 3 or more years' practical experience need apply. Engineer in Charge, Drafting Department, General Electric Co., Schenectady, N. Y.

Wanted—By a large fire-arm manufacturing concern, a competent man to take charge of heat-treatment operations, such as tempering, annealing, case-hardening, etc.; give detailed experience, age, salary expected and references. Box 759, AMERICAN MACHINIST,

Machine shop foreman; man used to interchangeable work and high-speed steel machinery; no heavy work; advantage to speak French; state experience, references and salary; confidential. Box 735, AMER. MACH.

Wanted—Immediately, several expert designers, experienced in designing jigs, dies and fixtures for small machine manufacture, also first-class toolmakers for the same work. Address P. O. Drawer No. 7, Syracuse, N. Y.

Wanted—An expert adjuster of hand and automatic turret machines; must thoroughly understand best methods of chucking and forming steel parts; familiarity with Acme and Cleveland machines desired. Box 761, AMERICAN MACHINIST.

Several draftsmen wanted; location, N. Y. city; original designing ability not essential; good positions to good men who are quick and accurate at dimensions; state age, experience, nationality and salary expected. Box 666, AMERICAN MACHINIST.

Wanted—Manager and superintendent, with experience in manufacture of high-grade sewing machines, overstitch and chainstitch; a brilliant opportunity, but only for a competent, experienced machinist and superintendent. Address L. N. Littauer, 715 Broadway, New York.

Shop Accountant and Cashier.—A manufacturing concern requires at once a thoroughly competent accountant, cashier and purchasing agent, familiar with these different lines of work, including general bookkeeping and modern cost systems. Address, with full particulars, stating salary expected, etc., Box 753, AMERICAN MACHINIST.

Speed boss or production engineer, as assistant to the superintendent of a company manufacturing steam and electric machinery; must be familiar with modern tools, speeds and methods of accurate and economical manufacture; salary $3,000 a year. Address, giving experience and qualifications, "A. B. C.," AMERICAN MACHINIST.

Wanted—Superintendent to take charge of an established and up-to-date plant manufacturing a line of A1 machine tools; must have push, energy and good executive ability, also be well up in modern machine shop practice; only men of ability need apply; state age, experience, salary expected, with references; all correspondence will be treated strictly confidential. Address Box 726, AM. MACH.

General Manager and Staff.—New company about to begin manufacture of an improved steam turbine, centrifugal pumps and turbine machinery on a large scale, desires to engage at once a general manager and necessary shop, office and sales assistants; applications are invited in confidence for different positions, stating fully the qualifications of the applicant for the position sought and salary expected. Permanent address should be given, as some positions may not be satisfactorily filled immediately. Address Box 748, AM. M.

PENNSYLVANIA.

Draftsman wanted at $2 to $3.50 per day; location, eastern Pennsylvania. Reply to "Machine Tools," care AMER. MACHINIST.

Wanted—Several first-class draftsmen for heavy machine tool work. Apply Superintendent's Office, Westinghouse Electric & Mfg. Co., East Pittsburg, Pa.

Wanted—First-class toolmakers and draftsmen at once; first-class workmen on jig and fixture work for light, high-grade machinery. Apply to the Taft-Peirce Mfg Co., Woonsocket, R. I.

Wanted—Experienced draftsmen in electrical apparatus, such as generators, motors and switchboards; only first-class men need apply; state experience and salary expected. Address Box 703, AMERICAN MACHINIST.

Wanted—Machinists and patternmakers. We are constantly adding to our force, and invite applications from machinists and patternmakers, preferably those accustomed to engine work. Shepherd Engineering Company, Franklin, Pa.

Foreman to take charge of modern equipped machine shop; 100 men; must be accustomed to modern methods of rapid production in a miscellaneous class of work; reply promptly, giving age, experience and salary expected. Address "X. Y.," care AMERICAN MACHINIST.

Wanted—A man of good business and executive ability and some capital, to take the management of a business requiring the introduction and putting on the market a new invention of undoubted merit and a large field of trade; it has been sufficiently introduced to prove it to be a success and a money-maker; have plant complete to manufacture. Box 750, AMERICAN MACHINIST.

WEST OF MISSISSIPPI.

Clarinet or 'cello player wanted for small pleasure orchestra; permanent employment for first-class mechanical draftsman or good warehouse stock clerk; location, Tennessee. Address Box 658, AMERICAN MACHINIST.

Wanted—General draftsman and designer, technical graduate, for growing concern in central California, manufacturing mining machinery especially; state age, experience, nationality and salary. Box 740, AMER. MACH.

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General Elec. Co., New York.
Sprague Elec. Co., New York.
Stanley G. I. Elec. Mfg. Co., Pittsfield, Mass.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Boring and Drilling Machines, Horizontal

Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Beaman & Smith Co., Provi., R. I.
Betts Mach. Co., Wilmington, Del.
Binsse Mach. Co., Newark, N. J.
Boynton & Plummer, Worcester, Mass.
Dallett Co., Thos. H., Phila., Pa.
Detrick & Harvey Mach. Co., Baltimore, Md.
Draper Mach. Tool Co., Worcester, Mass.
Fitchburg Machine Works, Fitchburg, Mass.
Fosdick Mach. Tool Co., Cin., O.
Gisholt Mach. Co., Madison, Wis.
Hill, Clarke & Co., Boston, Mass.
Lucas Mach. Tool Co., Cleve., O.
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Motch & Merryweather Machinery Co., Cleveland, O.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Pawling & Harnischfeger, Milwaukee, Wis.
Prentiss Tool & Supply Co., New York.
Ridgway Mach. Tool Co., Ridgway, Pa.
Springfield Mch. Tool Co., Springfield, O.
Vandyck Churchill Co., New York.
Warner & Swasey Co., Cleveland, Ohio.

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American Tool Wks. Co., Cin., O.
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Boring and Turning Mills *Continued*

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Gisholt Mach. Co., Madison, Wis.
Hill, Clarke & Co., Boston, Mass.
King Mach. Tool Co., Cincin., O.
Niles-Bement-Pond Co., New York.
Poole Co., J. Morton, Wilmington, Del.
Prentiss Tool & Supply Co., New York.
Ridgway Mach. Tool Co., Ridgway, Pa.
Vandyck Churchill Co., New York.
Warner & Swasey Co., Cleveland, Ohio.

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Armstrong Bros. Tool Co., Chicago, Ill.

Calipers

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Cams

Boston Gear Works, Boston, Mass.

Carborundum

See Grinding Wheels.

Castings, Die Molded

Franklin Mfg. Co., Syracuse, N. Y.

Castings, Iron

Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.
Farrel Fdry. & Mach. Co., Ansonia, Conn.
Massey Mach. Co., Watertown, N. Y.
U. S. Foundry & Sales Co., South Norwalk, Conn.

Castings, Steel

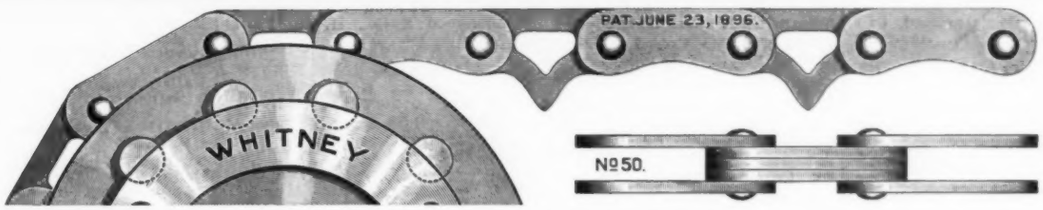
Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.
Farrel Fdry. & Mach. Co., Ansonia, Conn.

Catalogue Makers

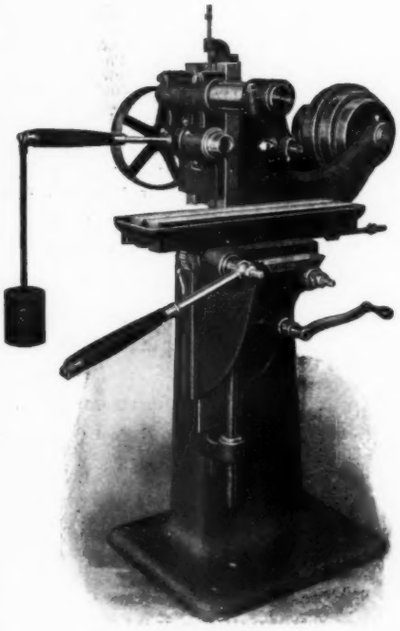
Binner-Wells Co., Chicago, Ill.

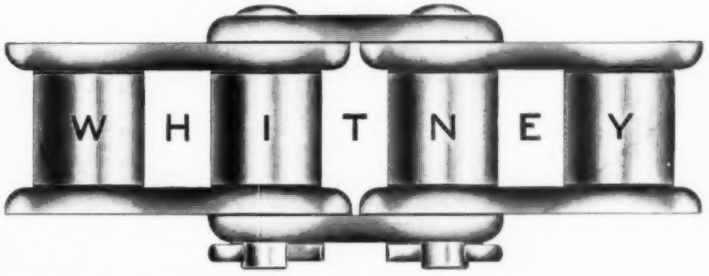
Cement, Cast Steel

Clark Cast Steel Cement Co., Shelton, Conn.

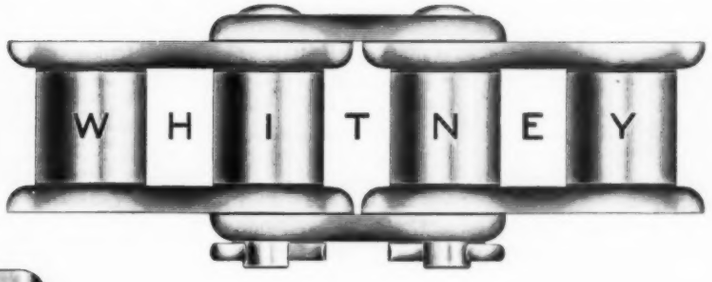


"WIZARD" Chains and Sprockets—Patented

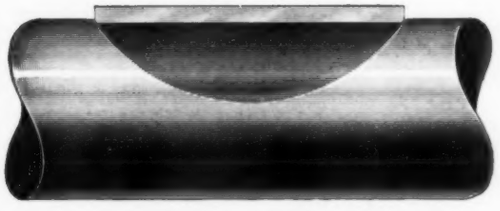




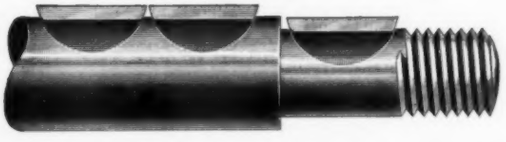
1906 Model "Whitney" Detachable Roller Chains—Patented



Block Chains



"Woodruff" Patent Keys



Three Popular Specialties

"Whitney" Chains
Hand (feed) Milling Machines
The Woodruff Patent System of Keying

THE WHITNEY MFG. COMPANY

HARTFORD, CONN., U.S.A.

FOREIGN AGENTS: C. W. Burton, Griffiths & Co., Great Britain. Schuchardt & Schutte, Germany, Austria, Holland, Russia and Scandinavia. Fenwick, Freres & Co., France, Belgium, Italy, Switzerland, Spain and Portugal.

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Link Belt Engr. Co., Phila., Pa.
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Jacobs Mfg. Co., Hartford, Conn.
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Dixon Crucible Co., Jos., Jersey City, N. J.

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Bury Compressor Co., Erie, Pa.
Christensen, N. A., Milwaukee, Wis.
Curtis & Co. Mfg. Co., St. Louis, Mo.
General Pneumatic Tool Co., Montour Falls, N. Y.
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See Schools, Correspondence.

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Whitney Mfg. Co., Hartford, Ct.

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Boynton & Plummer, Worcester, Mass.
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American Tool Wks. Co., Cin., O.
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Boynton & Plummer, Worcester, Mass.
Dallett Co., Thos. H., Phila., Pa.
Niles-Bement-Pond Co., New York.

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Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
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American Tool Wks. Co., Cin., O.
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Davis Mach. Co., W. P., Rochester, N. Y.
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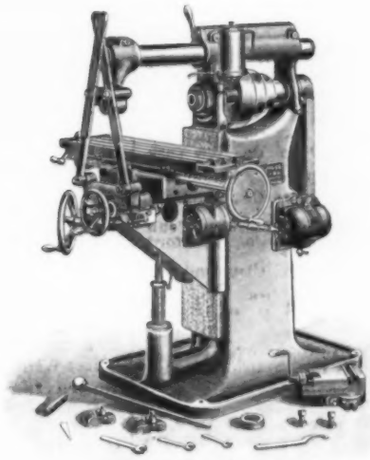
UP-TO-DATE

Plain Milling Machines



that are recognized as Standard for Accuracy and Quality of Workmanship. They have

Ample Driving Power

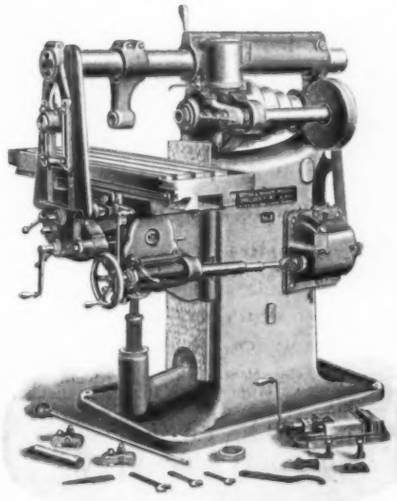
to carry any cut within the capacity of the machine.

Large Bearing Surfaces

to insure accuracy and maintenance of alignment.

All Levers and Hand Wheels

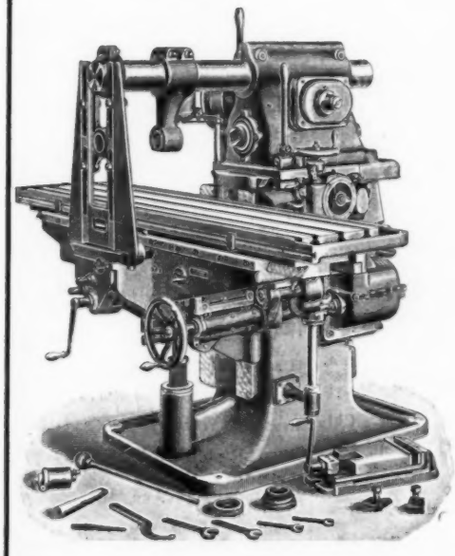
arranged for most convenient manipulation.



They are made in

15 Different Sizes,

covering a wide range of milling.

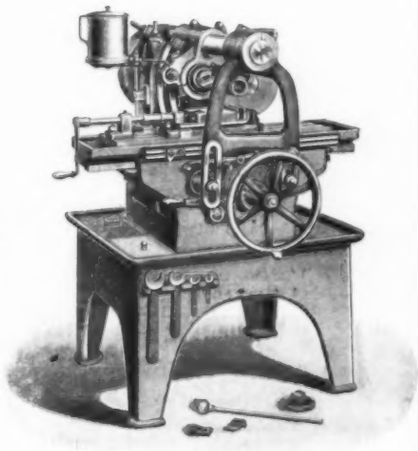


More than

300 Milling Machines

in almost constant operation at our works.

Our experience is at your service and may prove of value to you in selecting machines for your work.



Catalogue and descriptive circulars mailed free to any address.

Drills, Center
Pratt & Whitney Co., Hartford, Conn.
Slocomb Co., J. T., Providence, R. I.
Standard Tool Co., Cleveland, O.

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Sprague Elec. Co., New York.
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See Grinding Wheels.

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Reeves Pulley Co., Columbus, O.

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Foos Gas Engine Co., Springfield, Ohio.
Jacobson Mach. & Mfg. Co., Warren, Pa.
Mietz, August, New York.
New Era Gas Engine Co., Dayton, Ohio.
Olds Gasoline Engine Wks., Lansing, Mich.
Struthers-Wells Co., Warren, Pa.

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Mietz, August, New York.

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Ridgway Dynamo & Engine Co., Ridgway, Pa.
Struthers-Wells Co., Warren, Pa.
Sturtevant Co., B. F., Hyde Park, Mass.

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Gorton Mach. Co., Geo., Racine, Wis.

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Sturtevant Co., B. F., Hyde Park, Mass.

Exhibition, Machinery
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Extractor
Oil & Waste Saving Mach. Co., Philadelphia, Pa.

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General Electric Co., New York.
Northern Elec. Mfg. Co., Madison, Wis.
Sprague Elec. Co., New York.
Sturtevant Co., B. F., Hyde Park, Mass.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Fans, Exhaust
Sturtevant Co., B. F., Hyde Park, Mass.

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Filing Machines
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Filler, Iron
Clark Cast Steel Cement Co., Shelton, Conn.

Flexible Shafts
Chicago Flexible Shaft Co., Chicago, Ill.
Coates Clipper Mfg. Co., Worcester, Mass.

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Boynton & Plummer, Worcester, Mass.
Buffalo Forge Co., Buffalo, N. Y.
Ingersoll-Sergeant Drill Co., New York.
Miner & Peck Mfg. Co., New York.
Sturtevant Co., B. F., Hyde Park, Mass.

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Forgings, Steel
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American Gas Furnace Co., New York.

Furnaces, Enameling
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Chicago Fexible Shaft Co., Chicago, Ill.
Westmacott Co., J. M., Providence, R. I.

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American Gas Furnace Co., New York.

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New Britain Mach. Co., New Britain, Conn.

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Pratt & Whitney Co., Hartford, Conn.
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Gisholt Mach. Co., Madison, Wis.

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Brown & Sharpe Mfg. Co., Providence, R. I.
Caldwell & Son Co., H. W., Chicago, Ill.
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Fawcus Mch. Co., Pittsburg, Pa.
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Grant Gear Works, Boston, Mass.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
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Massey Mach. Co., Watertown, N. Y.
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Nuttall Co., R. D., Pittsburg, Pa.
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Caldwell & Son Co., H. W., Chicago, Ill.
Farrel Fdry. & Mach. Co., Ansonia, Conn.
Franklin Mfg. Co., Syracuse, N. Y.
Greenwald Co., I. & E., Cincin., O.
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Gears, Rawhide
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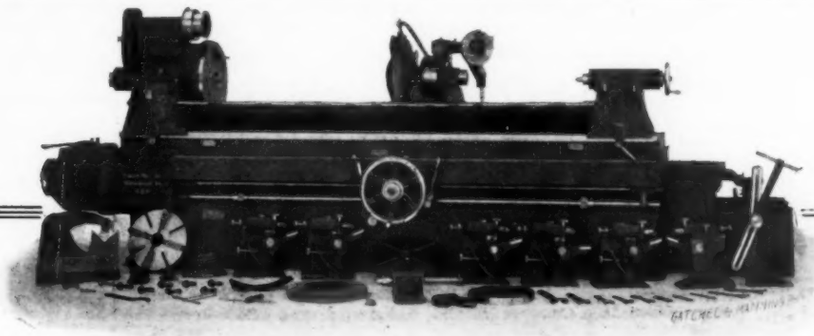

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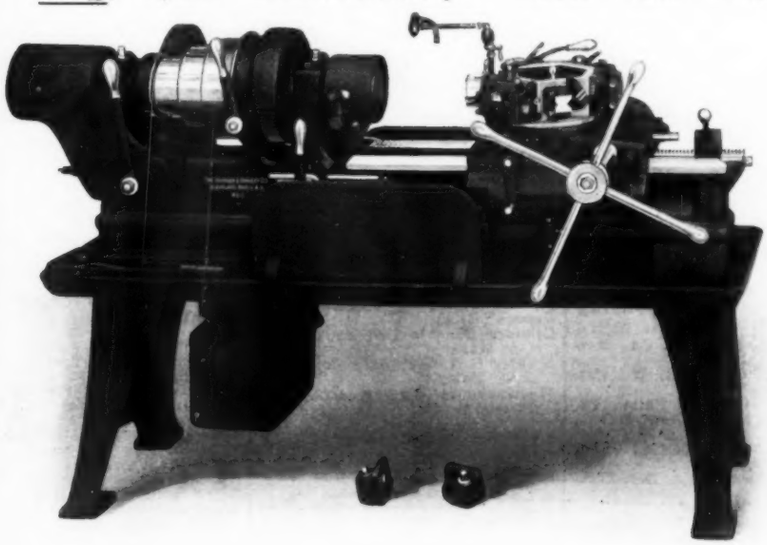

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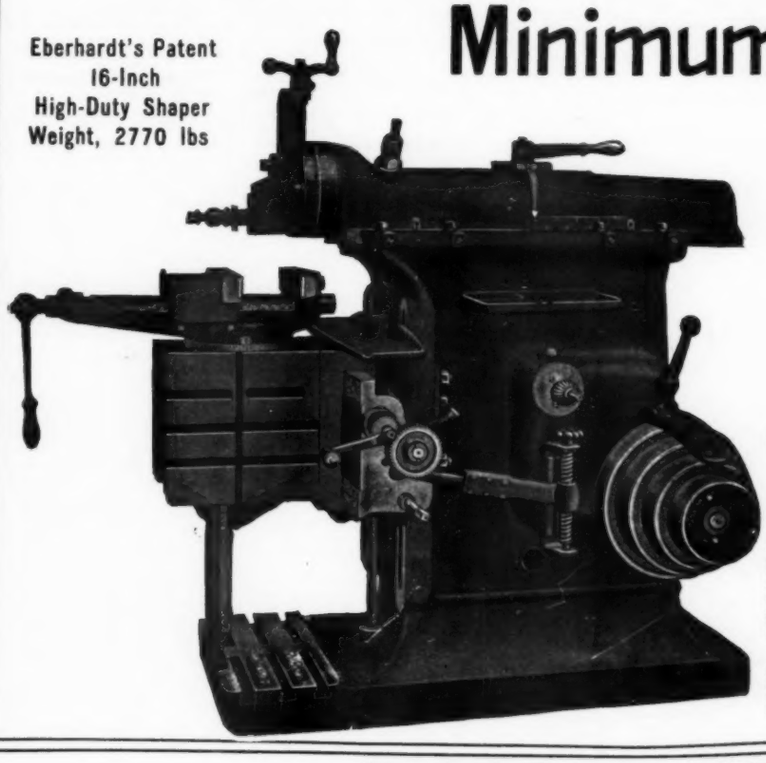

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Niles-Bement-Pond Co., New York.
Rivett Lathe Mfg. Co., Boston, Mass.
Waltham Watch Tool Co., Springfield, Mass.

Milling Machines, Hand
Whitney Mfg. Co., Hartford, Ct.

Milling Machines, Horizontal
Beaman & Smith Co., Prov., R. I.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Cincinnati Mill. Mach. Co., Cincinnati, O.
Hendey Mach. Co., Torrington, Ct.
Hess-Bright Mfg. Co., Phila., Pa.
Ingersoll Mill. Mach. Co., Rockford, Ill.
Kempsmith Mfg. Co., Milwaukee, Wis.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Hartford, Conn.

Milling Machines, Plain
Adams Co., Dubuque, Iowa.
American Tool Wks. Co., Cin., O.
Aurora Tool Works, Aurora, Ind.
Beaman & Smith Co., Prov., R. I.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati, O.
Fairbanks Co., New York.
Garvin Mach. Co., New York.
Hendey Mch. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
Kempsmith Mfg. Co., Milwaukee, Wis.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
McCabe, J. J., New York.
Marshall & Huschart Mchry. Co., Chicago, Ill.
Motch & Merryweather Machinery Co., Cleveland, O.
Niles-Bement-Pond Co., New York.
Owen Mach. Tool Co., Springfield, Ohio.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Vandyck Churchill Co., New York.
Whitney Mfg. Co., Hartford, Ct.

Milling Machines, Portable
Underwood & Co., H. B., Philadelphia, Pa.

Milling Machines, Universal
American Tool Wks. Co., Cin., O.
Aurora Tool Works, Aurora, Ind.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati, O.
Fairbanks Co., New York.
Garvin Mach. Co., New York.
Hendey Mach. Co., Torrington, Conn.
Hill, Clarke & Co., Boston, Mass.
Kempsmith Mfg. Co., Milwaukee, Wis.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
McCabe, J. J., New York.
Niles-Bement-Pond Co., New York.
Owen Mach. Tool Co., Springfield, Ohio.
Prentiss Tool & Supply Co., New York.
Vandyck Churchill Co., New York.
Waltham Watch Tool Co., Springfield, Mass.

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Adams Co., Dubuque, Iowa.
Beaman & Smith Co., Prov., R. I.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Clough, R. M., Tolland, Conn.
Garvin Mach. Co., New York.
Ingersoll Mill. Mach. Co., Rockford, Ill.
Newton Mch. Tool Works, Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Owen Mach. Tool Co., Springfield, Ohio.
Vandyck Churchill Co., New York.

Milling Tools, Adjustable
Geometric Tool Co., New Haven, Conn.
Rogers, Boat, Gage & Drill Wks., John M., Gloucester City, N. J.

Mining Machinery
Ingersoll-Sergeant Drill Co., New York.
Rand Drill Co., New York.

Molding Machines
Adams Co., The, Dubuque, Iowa.
Tabor Mfg. Co., Philadelphia, Pa.
Webster & Perks Tool Co., Springfield, O.

Mortising Machines, Chain
New Britain Mach. Co., New Britain, Conn.

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Burke Elec. Co., Erie, Pa.
C & C Electric Co., New York.
Coates Clipper Mfg. Co., Worcester, Mass.
Crocker-Wheeler Co., Ampere, N. J.
Electro Dynamic Co., Bayonne, N. J.
General Electric Co., New York.
Jantz & Leist Elec. Co., Cin., O.
Northern Electrical Mfg. Co., Madison, Wis.
Ridgway Dynamo & Engine Co., Ridgway, Pa.
Roth Bros. & Co., Chicago, Ill.
Sprague Electric Co., New York.
Stanley G. I. Elec. Mfg. Co., Pittsfield, Mass.
Sturtevant Co., B. F., Hyde Park, Mass.
Triumph Elec. Co., Cincinnati, O.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Motors, Pneumatic
Independent Pneumatic Tool Co., Chicago, Ill.

Name Plates
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Numbering Machines
Bates Machine Co., New York.

Nut Tappers
See Bolt and Nut Machinery.

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Bay State Stamping Works, Worcester, Mass.
Besly & Co., Chas. H., Chicago, Ill.

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Oil & Waste Saving Mach. Co., Philadelphia, Pa.

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Jenkins Bros., New York.

Packings, Hydraulic and Pneumatic
Watson-Stillman Co., New York.

Pans, Lathe
New Britain Mach. Co., New Britain, Conn.

Pans, Shop
Kilbourne & Jacobs Mfg. Co., Columbus, O.

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Baker Bros., Toledo, O.
Blount Co., J. G., Everett, Mass.
Greaves, Klusman & Co., Cin., O.
Mersfelder Pattern Co., Cin., O.
Prentiss Tool & Supply Co., New York.
Robbins, L., Worcester, Mass.

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Hartford Mach. Screw Co., Hartford, Conn.

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American Watch Tool Co., Waltham, Mass.
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Curtis & Curtis Co., Bridgeport, Conn.
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Cleveland Twist Drill Co., Cleveland, O.
Saunders' Sons, D., Yonkers, N. Y.
Standard Tool Co., Cleveland, O.

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Bilgram, Hugo, Philadelphia, Pa.
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Detrick & Harvey Mch. Co., Baltimore, Md.
Fairbanks Co., New York.
Fitchburg Machine Works, Fitchburg, Pa.
Garvin Mach. Co., New York.
Gray Co., G. A., Cincinnati, O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
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Hill, Clarke & Co., Boston, Mass.
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Motch & Merryweather Machinery Co., Cleveland, O.
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Whitcomb-Blaisdell Machine Tool Co., Worcester, Mass.
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Faneuil Watch Tool Co., Boston, Mass.
Rivett Lathe Mfg. Co., Boston, Mass.
Stark Tool Co., Waltham, Mass.

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Bliss Co., E. W., Brooklyn, N. Y.
Miner & Peck Mfg. Co., New Haven, Conn.
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Waterbury Farrel Fdry. & Mach. Co., Waterbury, Conn.

Presses, Forging
Chambersburg Engineering Co., Chambersburg, Pa.

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Chambersburg Engineering Co., Chambersburg, Pa.
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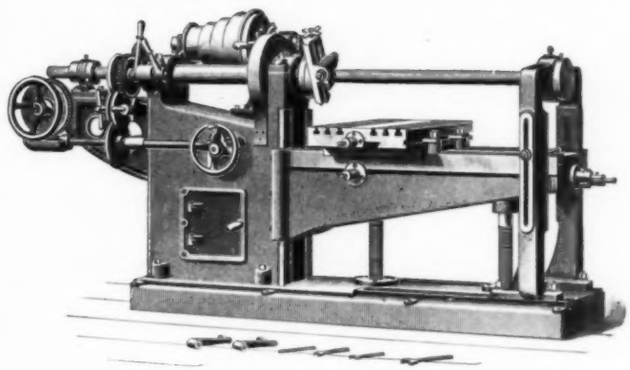

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Fellows Gear Shaper Co., Springfield, Vt.
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Standard Tool Co., Cleveland, O.
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Cutler-Hammer Clutch Co., Milwaukee, Wis.
General Elec. Co., New York.

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Standard Welding Co., Cleve., O.

Riveters, Hydraulic
Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.
Chambersburg Engineering Co., Chambersburg, Pa.
Niles-Bement-Pond Co., New York.
Watson-Stillman Co., New York.

Riveters, Pneumatic
Dallett Co., Thos. H., Phila., Pa.
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Niles-Bement-Pond Co., New York.
Rand Drill Co., New York.

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Auburn Ball Bearing Co., Rochester, N. Y.
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Hilles & Jones Co., Wilmington, Del.
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Waterbury Farrel Fdry. & Mach. Co., Waterbury, Conn.

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Slocomb Co., J. T., Provi., R. I.
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Lunkenheimer Co, Cincinnati, O.

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Drucklieb, C., New York.
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Obermayer Co., S., Cincin., O.

Saw Sharpening Machines
Nutter, Barnes & Co., Boston, Mass.

Sawing Machines, Metal
Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.
Cochrane-Bly Co., Rochester, N. Y.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Nutter, Barnes & Co., Boston, Mass.
Tabor Mfg. Co., Phila., Pa.
Tindel-Morris Co., Eddystone, Pa.
Vandyck Churchill Co., New York.
West Haven Mfg. Co., New Haven, Conn.

Sawing Machines, Wood
Colburn Mach. Tool Co., Franklin, Pa.
Seneca Falls Mfg. Co., Seneca Falls, N. Y.

Schools, Correspondence
American School of Correspondence, Chicago, Ill.
Columbia Correspondence Schools, Philadelphia, Pa.
International Correspon. Schools, Scranton, Pa.

Schools, Technical
Manhattan Automobile School, New York.

Screw Machines, Automatic
Automatic Mach. Co., Greenfield, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Automatic Mach. Co., Cleveland, O.
Dreses Mach. Tool Co., Cincin., O.
Hartford Mach. Screw Co., Hartford, Conn.
National-Acme Mfg. Co., Cleveland, O.
Pratt & Whitney Co., Hartford, Conn.
Windsor Mach. Co., Windsor, Vt.

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Cleveland Automatic Mach. Co., Cleveland, O.
Draper Mach. Tool Co., Worcester, Mass.
Garvin Mach. Co., New York.
Hartford Mach. Screw Co., Hartford, Conn.
Jones & Lamson Mch. Co., Springfield, Vt.
Potter & Johnston Mach. Co., Pawtucket, R. I.
Pratt & Whitney Co., Hartford, Conn.
Rivett Lathe Mfg. Co., Boston, Mass.
Warner & Swasey Co., Cleveland, Ohio.
Windsor Mach. Co., Windsor, Vt.

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Baker Bros., Toledo, O.
Cook Co., Asa S., Hartford, Ct.
Hammacher, Schlemmer & Co., New York.

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Cleveland Cap Screw Co., Cleveland, O.
Hammacher, Schlemmer & Co., New York.
Hartford Mach. Screw Co., Hartford, Conn.
National-Acme Mfg. Co., Cleveland, O.
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McDowell, Stocker & Co., Chicago, Ill.
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Prentiss Tool & Supply Co., New York.
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Fairbanks Co., New York.
Fitchburg Machine Works, Fitchburg, Mass.
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Gould & Eberhardt, Newark, N. J.
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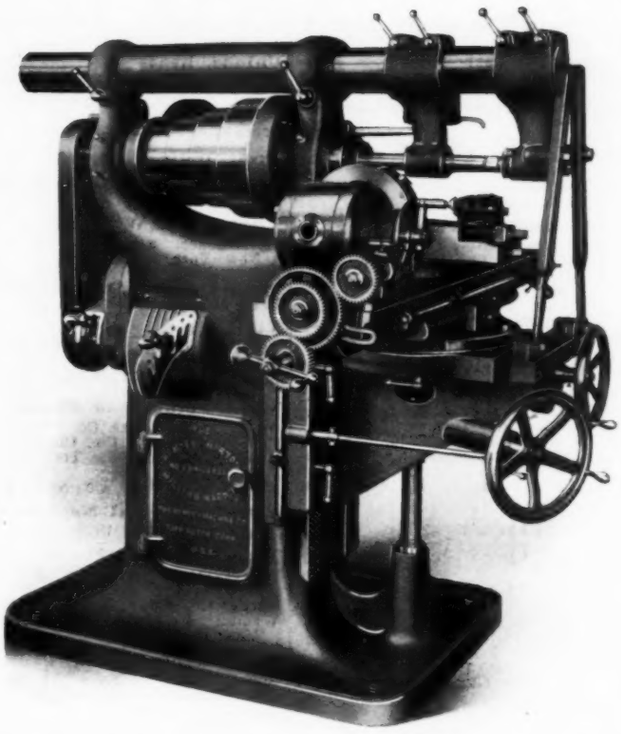

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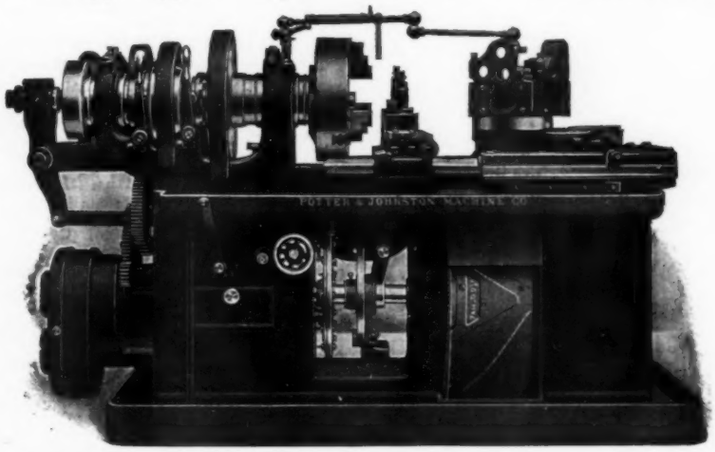

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Stampings, Welded
American Tube & Stamping Co., Bridgeport, Conn.
Standard Weding Co., Cleve., O.

Stamps, Steel
Schwerdtle Stamp Co., Bridgeport, Conn.

Steam Specialties
Jenkins Bros., New York.
Lunkenheimer Co., Cincinnati, O.

Steel, Machinery
Baldwin Steel Co., New York.
Boker & Co., Hermann, New York.
Firth-Sterling Steel Co., Demmler, Pa.
Kent & Co., Edwin R., Chicago, Ill.
McInnes Steel Co., Corry, Pa.
Morton & Co., B. K., Toronto, Canada.
Royal Metal Steel Co., New York.
Standard Gauge Steel Co., Beaver Falls, Pa.
Union Drawn Steel Co., Beaver Falls, Pa.
Ward & Son, Edgar T., Boston, Mass.

Steel, Sheet
American Tube & Stamping Co., Bridgeport, Conn.
Union Drawn Steel Co., Beaver Falls, Pa.
Ward & Son, Edgar T., Boston, Mass.

Steel, Tool
American Tube & Stamping Co., Bridgeport, Conn.
Baldwin Steel Co., New York.
Boker & Co., Hermann, New York.
Firth-Sterling Steel Co., Demmler, Pa.
Kent & Co., Edwin R., Chicago, Ill.
McInnes Steel Co., Corry, Pa.
Patterson, Gottfried & Hunter, Ltd., New York.
Phillips & Sons Co., F. R., Philadelphia, Pa.
Royal Metal Steel Co., New York.
Standard Gauge Steel Co., Beaver Falls, Pa.
Union Drawn Steel Co., Beaver Falls, Pa.
Vickers, Sons & Maxim, Sheffield, England.
Ward & Son, Edgar T., Boston, Mass.

Straightening Machinery
Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.
Fitchburg Machine Works, Fitchburg, Mass.
Hartford Mach. Screw Co., Hartford, Conn.
Springfield Mch. Tool Co., Springfield, O.

Straighteners, Hydraulic
Niles-Bement-Pond Co., New York.
Watson-Stillman Co., New York.

Swaging Machines
Excelsior Needle Co., Torrington, Conn.

Switchboards
C & C Electric Co., New York.
General Electric Co., New York.
Triumph Elec. Co., Cincinnati, O.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Switches
Cutler-Hammer Clutch Co., Milwaukee, Wis.
Stanley Elec. Mfg. Co., Pittsfield, Mass.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Tapes, Measuring
Keuffel & Esser Co., New York.
Starrett Co., L. S., Athol, Mass.

Tap Holders
Errington, F. A., New York.

Tapping Machines and Attachments
American Tool Wks. Co., Cin., O.
Baker Bros., Toledo, O.
Beaman & Smith Co., The, Providence, R. I.
Bickford Drill & Tool Co., Cin., O.
Cincinnati Mach. Tool Co., Cincinnati, O.
Errington, F. A., N. Y. City.
Fosdick Mach. Tool Co., Cin., O.
Garvin Mach. Co., New York.
Geometric Tool Co., New Haven, Conn.
Gould & Eberhardt, Newark, N. J.
Hartford Mach. Screw Co., Hartford, Conn.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Webster & Perks Tool Co., Springfield, O.
Whitney Mfg. Co., Hartford, Ct.

Taps and Dies
Bay State Tap & Die Co., Mansfield, Mass.
Besly & Co., Chas. H., Chicago, Ill.
Card Mfg. Co., S. W., Mansfield, Mass.
Carpenter Tap & Die Co., J. M., Pawtucket, R. I.
Cleveland Twist Drill Co., Cleveland, O.
Geometric Tool Co., New Haven, Conn.
Hammacher, Schlemmer & Co., New York.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Standard Tool Co., Cleveland, O.
Webster & Perks Tool Co., Springfield, O.
Wells Bros. Co., Greenfield, Mass.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Taps, Collapsing
Geometric Tool Co., New Haven, Conn.
Hemming Bros., New Haven, Conn.

Telephones
N. Y. Telephone Co., New York.

Thermit
Goldschmidt Thermit Co., New York.

Thread Cutting Tools
Besly & Co., Chas. H., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn.
Pratt & Whitney Co., Hartford, Conn.
Rivett-Dock Co., Boston, Mass.

Time Recorders
Simplex Time Recorder Co., Gardner, Mass.

Tool Holders
Armstrong Bros. Tool Co., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn.

Tool Holders—*Continued*
Hill-Standard Mfg. Co., Anderson, Ind.
Hoggson & Pettis Mfg. Co., New Haven, Conn.
O. K. Tool Holder Co., Shelton, Conn.
Pratt & Whitney Co., Hartford, Conn.

Tools, Small
See Machinists' Small Tools.

Transformers and Converters
General Elec. Co., New York.
Stanley G. I. Elec. Mfg. Co., Pittsfield, Mass.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Transmission Machinery
American Pulley Co., Phila., Pa.
Caldwell & Son Co., H. W., Chicago, Ill.
Case Mfg. Co., Columbus, O.
Cresson & Co., Geo. V., Philadelphia, Pa.
Eastern Mchy. Co., New Haven, Conn.
Link-Belt Engineering Co., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Reeves Pulley Co., Columbus, Ind.
Speed Changing Pulley Co., Indianapolis, Ind.
Wood's Sons, T. B., Chambersburg, Pa.

Traps, Steam
Sturtevant Co., B. F., Hyde Park, Mass.

Trolleys and Tramways
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Link-Belt Engineering Co., Philadelphia, Pa.
Maris Bros., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Yale & Towne Mfg. Co., New York.

Tubing, Steel
Almond Mfg. Co., T. R., Brooklyn, N. Y.
American Tube & Stamping Co., Bridgeport, Conn.

Turret Heads
Almond Mfg. Co., T. R., Brooklyn, N. Y.

Turret Machines
American Tool & Mach. Co., Boston, Mass.
Automatic Mach. Co., Greenfield, Mass.
Bradford Mach. Tool Co., Cincinnati, O.
Brown & Sharpe Mfg. Co., Providence, R. I.
Bullard Mach. Tool Co., Bridgeport, Conn.
Dieses Mach. Tool Co., Cincin., O.
Garvin Mach. Co., New York.
Gisholt Mach. Co., Madison, Wis.
Hill, Clarke & Co., Boston, Mass.
Jones & Lamson Mch. Co., Springfield, Vt.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Lodge & Shipley Mach. Tool Co., Cincinnati, O.
Massey Mach. Co., Watertown, N. Y.
Niles-Bement-Pond Co., New York.
Potter & Johnston Mach. Co., Pawtucket, R. I.
Pratt & Whitney Co., Hartford, Conn.
Springfield Mch. Tool Co., Springfield, O.
Warner & Swasey Co., Cleveland, Ohio.
Windsor Mach. Co., Windsor, Vt.

Twist Drills
Boker & Co., Hermann, New York.
Cleveland Twist Drill Co., Cleveland, O.
Hammacher, Schlemmer & Co., New York.
Morse Twist Drill & M. Co., New Bedford, Mass.
New Process Twist Drill Co., Taunton, Mass.
Niles-Bement-Pond Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Phillips & Sons Co., F. R., Philadelphia, Pa.
Royal Metal Steel Co., New York.
Standard Tool Co., Cleveland, O.
Whitman & Barnes Mfg. Co., Chicago, Ill.

Universal Joints
Baush Mach. Tool Co., Springfield, Mass.
Boston Gear Wks., Boston, Mass.
Gould & Eberhardt, Newark, N. J.
Gray & Prior Mach. Co., Hartford, Conn.
Mutual Machine Co., Hartford, Conn.

Unions, Brass
Lunkenheimer Co., Cincinnati, O.

Valves
See Steam Specialties.

Vises, Drill
Hopkinson Mach. Works, Springfield, Mass.

Vises, Metal Workers'
Hammacher, Schlemmer & Co., New York.
Millers Falls Co., New York.
Parker Co., Chas., Meriden, Conn.
Reed Mfg. Co., Erie, Pa.

Vises, Pipe
Curtis & Curtis Co., Bridgeport, Conn.
Saunders' Sons, D., Yonkers, N. Y.

Vises, Planer and Shaper
American Tool Wks. Co., Cin., O.
Cincinnati Planer Co., Cincin., O.
Hendey Mach. Co., Torrington, Conn.
Niles-Bement-Pond Co., New York.

Vises, Universal Machine
Graham Mfg. Co., Provi., R. I.

Vises, Wood Workers'
Hammacher, Schlemmer & Co., New York.
Parker Co., Chas., Meriden, Conn.
Wyman & Gordon, Worcester, Mass.

Watchmen's Clocks
Simplex Time Recorder Co., Gardner, Mass.

Welding
Goldschmidt Thermit Co., New York.

Welding, Electric
American Tube & Stamping Co., Bridgeport, Conn.
C & C Elec. Co., New York.
Standard Welding Co., Cleveland, Ohio.

Welding Machines
Long & Allstatter Co., Hamilton, Ohio.

Welding Plates
Phillips & Sons Co., F. R., Philadelphia, Pa.

Wire-Drawing Machinery
Iroquois Mach. Co., New York.
Waterbury Farrel Fdry. & Mach. Co., Waterbury, Conn.

Wire-Straightening Machinery
Hoefer Mfg. Co., Freeport, Ill.

Wood Working Machinery
Seneca Falls Mfg. Co., Seneca Falls, N. Y.

Worm Hobbing Machines
Pratt & Whitney Co., Hartford, Conn.

Worm Milling Machines
Cleveland Automatic Mach. Co., Cleveland, O.
Pratt & Whitney Co., Hartford, Conn.

Wrenches, Drop Forged
Billings & Spencer Co., Hartford, Conn.
Williams & Co., J. H., Brooklyn, N. Y.

Wrenches, Machinists'
Bemis & Call Hardware & Tool Co., Springfield, Mass.
Billings & Spencer Co., Hartford, Conn.
Coes Wrench Co., Worcester, Mass.
Hammacher, Schlemmer & Co., New York.
Whitman & Barnes Mfg. Co., Chicago, Ill.

Wrenches, Pipe
Bemis & Call Hardware & Tool Co., Springfield, Mass.
Bullard Automatic Wrench Co., Providence, R. I.